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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1780**

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Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **1802**

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Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **1817**

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Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **1827**

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Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **1833**

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Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **1841**

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **1857**

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Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **1901**

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Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **1973**

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Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **1980**

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Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **1984**

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Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **1995**

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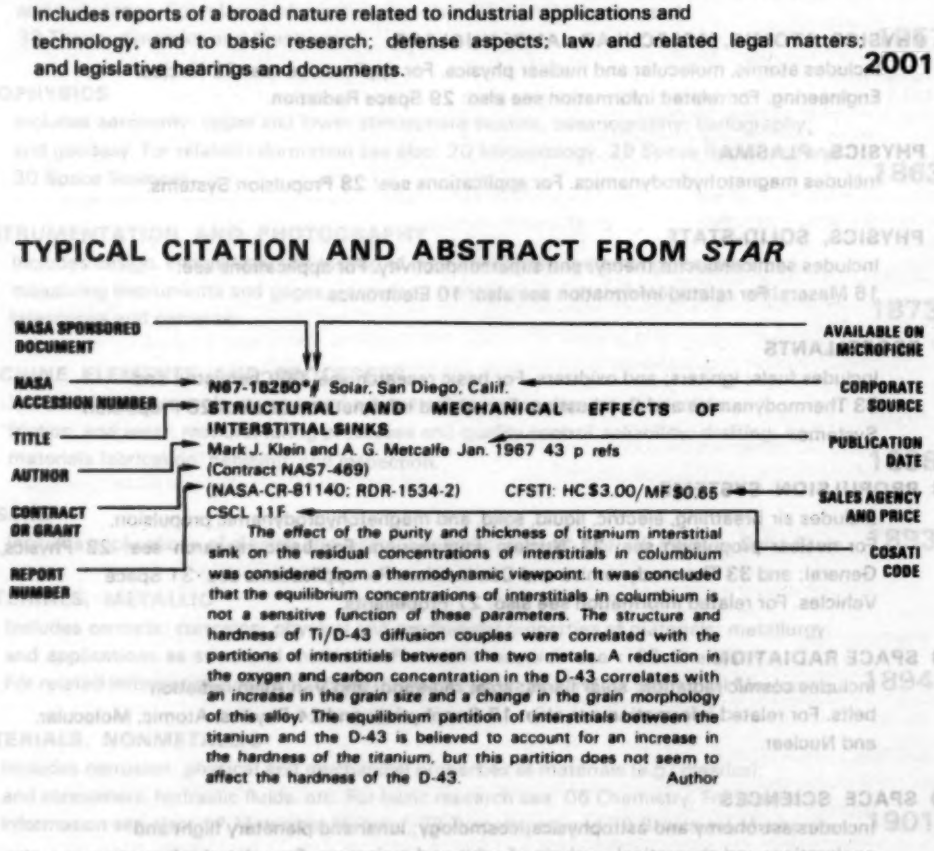
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TITLE
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
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Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
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REPORT NUMBER
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N67-22454# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
CIRCULAR-ARC JET FLAPS AT SUPERSONIC SPEEDS--TWO-DIMENSIONAL THEORY
James L. Amick Jul. 1966 76 p refs Prepared for APL
(APL/JHU-CR-24; Rept.-06089-2-T; AD-645731) CFSTI: HC $3.00/MF $0.65

An inviscid theory of jet-flap interaction is developed for a two-dimensional jet which issues from a curved nozzle and follows a circular-arc path such that the centrifugal force is in equilibrium with the pressure difference between a high pressure separated flow region along the upstream edge of the jet and a low pressure (base pressure) region along the downstream edge. The theory is based on empirical relations for the pressure in the separated flow region ahead of the jet flap. Results of a large number of numerical calculations are presented to show the effects of the various parameters. The most favorable interaction effects are shown to be associated with laminar separation ahead of weak jets at hypersonic speeds, but even for turbulent separation ahead of a strong jet (lift coefficient = .15) the normal force due to the jet is predicted to approach 7 times the thrust of an ideal jet in a vacuum, when the jet is inclined forward so that it has a substantial upstream component. The theoretical results for circular-arc jet flaps are compared with those for flaps issuing from straight nozzles at the same pressure as that of the upstream separated flow region, and the two types of fully-expanded jets are found to give almost identical results. The lifting efficiency of a jet flap is predicted to compare favorably with that of a flat plate airfoil at angle of attack, for high lift coefficients at hypersonic speeds. Author (TAB)

N67-22671# Itek Corp., Palo Alto, Calif. Vidya Div.
THEORETICAL STUDY OF DUCTED PROPELLER BLADE LOADING, DUCT STALL AND INTERFERENCE Final Report
Michael R. Mendenhall, Anthony R. Kriebel, and Selden B. Spangler 19 Sep. 1966 171 p refs
(Contract NOw-65-0348-c)
(VIDYA-229; AD-646022) CFSTI: HC $3.00/MF $0.65

A theoretical analysis was made to predict the performance of an isolated ducted propeller, with emphasis on real propeller and frictional effects. The various tasks performed are the following. An analysis was developed to predict, for a specified propeller and duct configuration, the performance in axial flow. The quantities predicted include propeller and duct thrust, propeller inflow velocity, and radial distribution of propeller loading and angle of attack. As a special case of this analysis, a method was developed to design a propeller for uniform loading in axial flow for a given duct. Two FORTRAN IV computer programs were developed for these methods and are available from the sponsor. A relatively simple and rapid method for estimating the flow conditions for onset of duct stall was developed. The effects of radial and circumferential variations of blade loading on ducted propeller performance were estimated. Finally, the effects of mutual interference between pairs of ducted propellers were investigated. Author (TAB)

N67-22690# Martin Co., Orlando, Fla.
RESEARCH STUDY TO VERIFY AND EXTEND HIGH SPEED MATH MODEL FOR JET REACTION CONTROL EFFECTIVENESS Final Report
R. D. McDonald and M. W. Garbrick Aug. 1966 121 p refs
(Contract DA-01-021-AMC-12515(Z))
(OR-8439; AD-645641) CFSTI: HC $3.00/MF $0.65

An analytical model was developed to predict the performance of a two-dimensional, reaction control jet exhausting normal to supersonic and hypersonic streams. The separation of a turbulent boundary layer upstream of the jet and the pressure field downstream of the jet were studied. A wind tunnel test of a jet slot on a flat plate model was conducted. The existing flow model was revised to give improved accuracy of the predictions of the interference effects upstream of the jet. The flow model was extended to include interference effects downstream of the jet. Author (TAB)

N67-22707# Royal Aircraft Establishment, Farnborough (England).
THE APPLICATION OF KNOWN FLOW FIELDS TO THE DESIGN OF WINGS WITH LIFTING UPPER SURFACES AT HIGH SUPERSONIC SPEEDS
K. C. Moore Feb. 1965 20 p refs
(RAE-TR-65034) CFSTI: HC $3.00/MF $0.65

Known axisymmetric flow fields are used as the basis of the design of the lower, compression surfaces and the upper, expansion surfaces of wings for cruising flight at high supersonic speeds. Two examples are given for a Mach number of 4. Author

N67-22709# Royal Aircraft Establishment, Farnborough (England).
THE FORCES ON A COMPRESSION SURFACE BASED ON AN AXISYMMETRICAL CONICAL FLOW FIELD
B. A. Woods Oct. 1964 19 p refs
(RAE-TR-64035) CFSTI: HC $3.00/MF $0.65

Formulas are derived for calculating the lift, drag, and pitching moment on a surface based on an axisymmetrical conical flow field (a Jones wing). They involve in each case the numerical integration of functions of one variable, and are therefore in forms convenient for machine computation. Results obtained using the formulas in an illustrative calculation are given. Author

N67-22713 Royal Aircraft Establishment, Farnborough (England).
PRELIMINARY LOW SPEED MEASUREMENTS OF SKIN-FRICTION AND SURFACE PRESSURE-FLUCTUATIONS ON A SLENDER WING AT INCIDENCE
L. A. Wyatt and T. B. Owen Sep. 1963 18 p refs
(RAE-TN-AERO-2916) CFSTI: $3.00

The distribution of skin friction over the upper surface of a slender sharp-edged delta wing at incidence has been measured using surface pitot tubes. Beneath the leading-edge vortex, the surface shear stress reaches a peak value about twice the levels observed in the regions inboard of the main vortex and outboard of the secondary separation. Corresponding measurements of surface pressure fluctuations are found to correlate well with the local skin friction. This correlation supports the view that the surface pressure fluctuations observed beneath a leading-edge vortex are not generated directly by or within the vortex but are an inherent feature of the boundary layer. Author

N67-22720# Royal Aircraft Establishment, Farnborough (England).
SUPERSONIC FLUTTER DERIVATIVES FOR A SERIES OF SWEPT AND CROPPED DELTA WINGS
G. Z. Harris Jan. 1966 31 p refs
(RAE-TR-66003) CFSTI: HC $3.00/MF $0.65

A program for the experimental and theoretical determination of flutter derivatives for a series of swept and cropped delta wings was initiated. This report gives values of the pitching and heaving derivatives for a number of these planforms in the intermediate supersonic speed range. The derivatives have been found using supersonic lifting surface theory. Author

N67-22733# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
A PRELIMINARY STUDY OF THE FLOW FIELD AROUND A BLUNT BODY IN HYPERSONIC LOW DENSITY FLOW
Duvvuri Tirumalesa Nov. 1966 30 p refs
(Grant AF-AFOSR-697-67)
(USCAE-105; AFOSR-66-2701; AD-645117) CFSTI: HC $3.00/MF $0.65

The local temperature and density profiles in the stagnation region of a hemisphere-cylinder body placed in a flow of nitrogen are presented. The Mach number was 9.16, the Reynolds number was 350 per inch and the Knudsen number was 0.045. The stagnation temperature was 298K. The model was cooled with liquid nitrogen. The local density and temperature were measured with an electron beam. The rotational temperature was corrected using Robben and Talbots experimental curve. The measurements indicate that the local to free stream temperature ratio across the shock layer continuously increases towards the body and reaches a value smaller than the inviscid shock value, whereas the density also increases continuously but reaches a higher value than the inviscid shock value. Author (TAB)

N67-22777*# Goodyear Aerospace Corp., Akron, Ohio.
WAKES, THEIR STRUCTURE AND INFLUENCE UPON AERODYNAMIC DECELERATORS
Igor M. Jaremenko Washington, NASA, Apr. 1967 69 p refs
(Contract NASw-1288)
(NASA-CR-748) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The macro- and microstructure of the wake flow is presented covering the present state of the art of wake research. The decelerator-in-the-wake phenomenon is explained, and attempts to predict the influences of a wake on decelerator performance and design are described. It is shown that since no rigorous analytical treatment is available for this flow regime, the solutions are either approximate or similar. A summary of the experimental data concerning the influence of wakes upon aerodynamic decelerators and the drag efficiency and stability of a particular decelerator behind a particular payload are given. Author

N67-22784# National Physical Lab., Teddington (England). Aerodynamics Div.
CALCULATIONS OF TRANSIENT FORCES ON DELTA WINGS
B. D. Dore 29 Sep. 1965 24 p refs
(NPL-AERO-1033; ARC-27279; AD-476531) CFSTI: HC $3.00/MF $0.65

Under the assumptions of linear theory, transient lift and moment functions are considered for finite wings in incompressible flow. For sudden plunging motion, these functions have been calculated for complete delta wings of aspect ratios 1, 2 and 4 by using the lift and moment coefficients due to oscillatory plunging motion. Growth of lift functions due to gust entry have also been calculated for these wings, together with that for the true limiting case as aspect ratio tends to infinity. Author (TAB)

N67-22789# Aeronautical Research Council (Gt. Brit.)
A PROBLEM OF WING-BODY INTERFERENCE
D. G. Randall Apr. 1963 25 p refs Supersedes RAE-AERO-2676; ARC-24953; See X63-14968
(ARC-CP-704; RAE-AERO-2676; ARC-24953) CFSTI: HC $3.00/MF $0.65

The report considers inviscid, supersonic flow past a symmetrical wing-body combination at zero incidence. The body is a circular cylinder extending indefinitely in both the upstream and the down stream directions. The wings are two halves of a delta wing of single-wedge section with a subsonic leading edge; they are assumed to extend indefinitely in the downstream direction. Results are obtained for the pressure distribution on the body. Author

N67-22790# Aeronautical Research Council (Gt. Brit.)
SUPERSONIC WIND TUNNEL MEASUREMENTS OF THE LOADS AND INTERNAL PRESSURE DISTRIBUTIONS ON DUSTS AT INCIDENCE
P. H. Cook Feb. 1964 66 p refs Supersedes RAE-TN-AERO-2951; ARC-26009; See N65-20513
(ARC-CP-768; RAE-TN-AERO-2951; ARC-26009) CFSTI: HC $3.00/MF $0.65

An attempt has been made to find a method of estimating the external lift of full scale engine nacelles and the internal lift of rectangular cross section ducts used to represent engine nacelles on wind tunnel models. The results for the total lift curve slope of circular cross section ducts look promising in that an adequate collapse of the experimental data has been achieved. For the rectangular ducts, the internal lift at low incidence may be predictable if the internal flow Mach number is known, and the available results for total lift suggest a similar collapse to that achieved for the circular ducts. The experimental data for the rectangular ducts are limited. Author

N67-22799# Aeronautical Research Council (Gt. Brit.)
THE PRESSURE DISTRIBUTION AT ZERO-LIFT ON SOME SLENDER DELTA WINGS AT SUPERSONIC SPEEDS
M. C. P. Firmin Nov. 1963 36 p refs Supersedes RAE-TN-AERO-2926; ARC-25708; See X64-13163
(ARC-CP-774; RAE-TN-AERO-2926; ARC-25708) CFSTI: HC $3.00/MF $0.65

The pressure distribution has been measured on the rear of a slender delta wing with rhombic cross sections as part of a program to investigate the influence on the wave drag of thickness distributions that give rise to a marked adverse pressure gradient and a relatively large suction near the trailing edge. Even for such non-smooth thickness distributions, thin wing theory gives fair results. It has, however, been found that a form of second-order inviscid perturbation theory (not-so-thin wing theory) gives much more reliable results. Author

N67-22882* Alpha Research Inc., Santa Barbara, Calif.
NON-LINEAR AERODYNAMIC NORMAL FORCE AND MOMENT ON SLENDER BLUNT-BASED BODIES OF REVOLUTION WITH LAMINAR BOUNDARY LAYER

Ray W. Rodman 27 Mar. 1967 34 p refs
(Contract NAS2-3426)
(NASA-CR-73079; Rept.-67-3426-1) CFSTI: $3.00 CSCL 01A

A method based on revised crossflow concepts is presented for the estimation of the nonlinear normal force and moment on slender, blunt-based bodies of revolution. The method is applicable to both subsonic and supersonic flows, and covers the angle of attack range of zero to ninety degrees. Comparisons with experimental normal force distributions show that the correct form of the longitudinal normal force distribution is provided. The method is strictly applicable only to the case of a fully laminar boundary layer over the entire body length. However, some effects of boundary layer transition are pointed out. Since the turbulent crossflow drag coefficient is strongly a function of angle of attack, an essential difference exists between laminar and turbulent crossflow separation over bodies of revolution. Author

N67-22897*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TABLES OF INTERFERENCE FACTORS FOR USE IN CORRECTING DATA FROM VTOL MODELS IN WIND TUNNELS WITH 7 BY 10 PROPORTIONS
Harry H. Heyson Washington, NASA, 1967 653 p refs
(NASA-SP-3039) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Because of the widespread use of wind tunnels having 7 by 10 proportions, tables of interference factors are presented for VTOL models whose span is parallel to either the long or the short side of the wind tunnel; and instructions for the use of these values for semispan models are included. Factors for use in obtaining tail corrections of finite-span models are discussed; along with longitudinal, lateral, and vertical distributions. The tables are presented directly from the computer outputs. M.W.R.

N67-22903# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDYING THE GROUND-EFFECT IN WIND-TUNNELS [ETUDE EN SOUFFLERIE DE L'EFFECT DE SOL]
Alexandre de Sievers Dec. 1966 53 p refs In FRENCH; ENGLISH summary
(ONERA-TN-87) CFSTI: HC $3.00/MF $0.65

Following a brief survey of the theoretical methods used for ground-effect prediction in the most simple cases, the experimental methods are described including a comparison of the results obtained in the wind-tunnel, of the O.N.E.R.A. Center at Cannes, in both cases of the image and fixed-flow methods applied to slender wings. In spite of the imperfection of the latter method due to development of a boundary-layer on the simulated flow, the approximation obtained is satisfactory when the model (wing or airplane) is sufficiently slender. Systematic investigations carried out with such wings have permitted to determine the coefficients used in two empirical corrections concerning lift and drag close to the ground and determined from a C_L versus C_D curve without ground-effect. In an appendix the calculation of the wall effect is given for a circular test-section in both cases; simulated floor parallel to the tested wing and image method. Author (ESRO)

N67-22926# Eidgenossische Technische Hochschule, Zurich (Switzerland).
DETERMINATION OF WING EFFECTS ON NORMAL BODY FORCES FOR WING-BODY COMBINATIONS AT SUPERSONIC SPEED [ZUR BESTIMMUNG DER FLUEGELEINFLUESSE AUF DIE RUMPFNORMALKRAEFTE BEI FLUEGEL-RUMPF-KOMBINATIONEN IM UEBERSCHALL]
Alain G. Mona 1965 191 p refs In GERMAN
(PROM.-3786) CFSTI: HC $3.00/MF $0.65

A method is proposed for determining interference forces and the effects of a lifting wing on a body in the supersonic range. The method is based on a breakdown of the wing forces acting on the body into two components: effect of wing without downwash, and effect of downwash. Calculations were performed for a body combined with rectangular, trapezoid, and delta wings, and good agreement was obtained with experimental results. The effectiveness of the method was demonstrated on a body–wing–tail combination with an extended tail section at angles of attack up to 12° and at three different Mach numbers. Accuracy of the calculations was within ±5% for the total active forces and within ±2% for location along total length of the body. Practical application of the method is facilitated by the reasonable amount of calculations. Transl. by K.W.

N67-23241# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FREE-FLIGHT TESTING IN HIGH-SPEED WIND TUNNELS
Bain Dayman, Jr. Paris, AGARD, May 1966 99 p refs
(AGARDograph-113) CFSTI: HC $3.00/MF $0.65

The adaptation of free-flight techniques to testing in a conventional wind tunnel is described in enough detail that it can be applied to other facilities with a minimum amount of development. Examples and results of many applications are included in order to demonstrate the need and advantages for using this free-flight technique. Author

N67-23245# Canadian Armament Research and Development Establishment, Valcartier (Quebec).
TRANSONIC STABILITY OF FIN AND DRAG STABILIZED PROJECTILES
B. Cheers Paris, AGARD, May 1966 39 p refs Presented at AGARD Fluid Dyn. Panel Specialists' Meeting, Rhode-Saint-Genese, Belgium, 10–13 May 1966
(AGARD-542) CFSTI: HC $3.00/MF $0.65

A review has been made of the data, published in the unclassified literature, on the stability and drag characteristics of projectiles, with either spike noses (high drag) or pointed noses (low drag), at supersonic and transonic speeds. Both theoretical and experimental results have been considered, where available, and areas where further work may prove useful are mentioned. Author

N67-23249# Bristol Siddeley Engines, Ltd. (England).
CHANGES IN THE FLOW AT THE BASE OF A BLUFF BODY DUE TO A DISTURBANCE IN ITS WAKE
R. Hawkins and E. G. Trevett Paris, AGARD, May 1966 27 p refs Presented at AGARD Specialists' Meeting on Separated Flows, Rhode-Saint-Genese, Belgium, 10–13 May 1966
(AGARD-539) CFSTI: HC $3.00/MF $0.65

An experimental study is presented on the interaction between a shock wave and the turbulent wake shed from a bluff-ended cylinder at free-stream Mach numbers between 1.2 and 1.9. A critical interaction distance is defined, beyond which point disturbances have no effect upon the flow at the base of the body. Correlation is made with comparable data for transitional wake flow. Author

N67-23290*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC PERFORMANCE OF SEVERAL BASIC AND MODIFIED DIAMOND-CROSS-SECTION DELTA-WING CONFIGURATIONS
Leonard M. Weinstein and Luther Neal, Jr. Washington, NASA, Apr. 1967 29 p refs
(NASA-TN-D-3894) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation of the performance of several delta wings was conducted in the 11-inch hypersonic tunnel. The unmodified models had leading-edge sweep angles ranging from 60° to 82° and ratios of base thickness to root chord from about 0.08 to 0.21. These models were tested at free-stream Mach numbers of 6.8 and 9.7 over a range of free-stream Reynolds numbers based

on root chord from 0.3×10^6 to 3.2×10^6. The effects of the various modifications (removal of parts of the top, bottom, and tips) were studied at a Mach number of 6.8 and a free-stream Reynolds number based on root chord of 1.4×10^6. The results showed that for the unmodified models the maximum lift–drag ratio increased with increasing free-stream Reynolds number based on root chord, but the increase was less than the amount indicated by laminar theory, which included the effects of viscous interaction. The lesser increase was probably due to the onset of transitional flow. For the same Reynolds number, the values of maximum lift–drag ratio were lower at Mach 9.7 than at Mach 6.8 by an amount roughly equal to that predicted by theory. All modifications increased the maximum lift–drag ratio; however, the magnitudes of maximum lift–drag ratio were 10 to 15 percent lower than the theoretical values. The major geometric correlating parameter was found to be an effective thickness ratio defined as the mean local thickness ratio. Author

N67-23296*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF SEVERAL HIGH-DRAG BODIES AT MACH NUMBERS FROM 1.50 TO 4.63
James F. Campbell Washington, NASA, Apr. 1967 34 p refs
(NASA-TN-D-3915) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation was conducted to determine the static longitudinal aerodynamic characteristics of entry bodies. A 100° cone, a 120° cone, and a tension-shell-shape model were tested at angles of attack to about 50°; most of these tests were performed at a Reynolds number based on model diameter of 2.0×10^6. The results of the investigation indicated that all three configurations are statically stable at low angles of attack in the test Mach number range and that the two cones are stable throughout the entire test angle-of-attack range. The tension-shell model, however, produced highly nonlinear variations of pitching moment, lift, and drag at angles of attack beyond about ±2° for Mach numbers above 1.90. These nonlinearities are caused by asymmetrical shock patterns and would probably lead to unsatisfactory stability characteristics for a vehicle following a zero-lift trajectory. The axial force (and drag) coefficient for the 120° cone is generally greater than for the other two test vehicles throughout the Mach number range. Author

N67-23341*# Pratt and Whitney Aircraft, East Hartford, Conn.
COMPRESSOR RESEARCH PACKAGE FOR RESEARCH AND DEVELOPMENT OF HIGH PERFORMANCE AXIAL-FLOW TURBOMACHINERY Final Report
R. Cohen, W. K. Gilroy, and R. D. Marchant Mar. 1967 97 p refs
(Contract NAS3-4179)
(NASA-CR-54884; PWA-2933) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The compressor research package is a test rig intended to provide aerodynamic performance data for the Brayton-cycle axial flow compressor. This compressor is a six-stage unit having a tip diameter of approximately 3.5 inches and was designed to provide a high efficiency potential. The compressor research package provides a convenient mechanical configuration for aerodynamic testing. The unit with unbladed rotor has been constructed and tested mechanically to twenty per cent over its design speed. Author

N67-23348# Clemson Coll., S. C.
A STUDY OF SPLITTER EFFECT IN CONICAL DIFFUSERS Final Report, Jul. 1963–Aug. 1966
Tah-teh Yang Aug. 1966 3 p refs
(Contract DA-31-124-ARO(D)-148)
(AROD-4390-4; AD-644905) CFSTI: HC $3.00/MF $0.65

The findings of the study were reported at different stages of the progress in various forms with titles as follows: Theory of a thin ring-airfoil in an incompressible inviscid source flow field; The effect of turbulent intensity on the efficiency of conical diffusers; The effect of splitter on turbulence intensity and pressure recovery efficiency in Conical diffusers; Inlet boundary layer effect on the pressure recovery efficiency of conical diffusers with and without a splitter; Splitter effect in conical diffusers part-1 experimental phase incompressible flow; Radius effect of a ring-airfoil on conical diffuser performance; Velocity distribution along the wall of a two-dimensional diffuser with a pair of vanes; Splitter effect in conical diffuser part-2 optimum design of a splitter (ring-airfoil) in a conical diffuser; Splitter effect in conical diffuser part-3 compressibility and scaling effect, experimental-part-4 pressure distribution along a conical diffuser with ring-airfoil, analytical. TAB

N67-23437# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
AERODYNAMIC CHARACTERISTICS OF ARBITRARY THREE-DIMENSIONAL SHAPES AT HYPERSONIC SPEEDS
Arvel E. Gentry [1966] 31 p refs Presented at Intern. Council of the Aeron. Sci. 5th Congr., London, 12–16 Sep. 1966
(Douglas Paper-3649)

Techniques for aerodynamic analysis of complex shapes in hypersonic flow are presented. The analysis is capable of handling completely arbitrary shapes and provides optional force-calculation methods for use as required. Techniques for describing arbitrary shapes are presented and the various force-calculation methods and their applicability are discussed. A procedure developed to check the accuracy of the geometric data uses a computer and automatic recorder to draw pictures of the vehicle viewed from any angle. Several examples demonstrate the use of this analysis in design studies. The calculated results are in excellent agreement with experimental data, even for complex shapes previously difficult to analyze. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-22451# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
LATERAL-DIRECTIONAL FLYING QUALITIES FOR POWER APPROACH Final Report, May 1964–Sep. 1966
Edward Seckel, George E. Miller, and Walter B. Nixon Sep. 1966 144 p refs
(Contracts Nonr-1858(50); N600(19)-59256; Grant NSF GP-579)
(Rept.-727; AD-644831) CFSTI: HC $3.00/MF $0.65

Simulated carrier approaches were flown by Navy carrier pilots in a variable stability Navion airplane. The approaches were visual, in daylight, at a closure speed of 105 knots. Moderate natural turbulence and the carrier turbulence wake were simulated. Lateral-directional handling qualities data in the form of Cooper rating number and pilot commentary were obtained for variations in control sensitivity, roll damping, dihedral effect, numerator transfer function characteristics, Dutch roll damping, and magnitude of turbulence. The data are presented as iso-opinion maps of the parameters. Turbulence was found to be a factor of commanding

importance in the handling qualities of a configuration. The poor handling qualities normally associated with large values of Dutch roll bank to sideslip ratio were found to be chargeable to the large value of the dihedral effect and the associated sensitivity of turbulence. Very low values of dihedral effect were objectionable because of the yawing motions excited by turbulence. Author (TAB)

N67-22534# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT CONSTRUCTION
V. L. Bel'skiy, I. P. Vlasov et al [1966] 198 p Transl. into ENGLISH from RUSSIAN
(GTD-TT-65-1573; TT-67-60425; AD-645767) CFSTI: HC $3.00/MF $0.65

Contents: Criteria of aircraft efficiency and fundamental design requirements; External shapes for winged flying craft; Vertical takeoff and landing (VTOL) aircraft; Pressurized fuselage compartments and the methods used in their strength calculation; Construction under conditions of high temperatures. TAB

N67-22600# United Aircraft Corp., Stratford, Conn.
HELICOPTER ROTOR NOISE GENERATION AND PROPAGATION
Ronald Schlegel, Robert King, and Harold Mull Ft. Eustis, Va., Army Aviation Mater. Labs., Oct. 1966 115 p refs
(Contract DA-44-177-AMC-141(T))
(USAAVLABS-TR-66-4; AD-645884) CFSTI: HC $3.00/MF $0.65

An improved method is presented for calculating rotor system overall vortex noise and frequency spectra for stalled and unstalled rotors. Correlation of measured and predicted vortex noise was evaluated using two rotor systems operating over a wide range of speeds and thrusts. Correlation was found to be excellent. Blade tip planform studies revealed significant vortex noise reductions with tapered tips. A new procedure is also derived for calculating near and far field rotor rotational noise with nonuniform inflow. The method extends the standard steady load method by including the effects of harmonic airloads. Correlation studies were conducted using an H-34 helicopter. Agreement between low frequency measured and predicted noise was good. However, correlation with high harmonic rotational noise was poor. This is probably due to inadequate definition of high harmonic airloads. The study was performed for single rotor systems only, and in its present form is not directly applicable to systems with multiple rotors in juxtaposition. Author (TAB)

N67-22672# General Electric Co., Cincinnati, Ohio. Advanced Technology and Demonstrator Programs Dept.
XV-5A LIFT FAN FLIGHT RESEARCH AIRCRAFT: FLUTTER MODEL TEST REPORT
Jun. 1966 21 p refs
(Contract DA-44-177-TC-715)
(Rept.-168; AD-646000) CFSTI: HC $3.00/MF $0.65

The report covers the wind-tunnel testing, in the flutter regime of a dynamically similar model of the XV-5A Lift-Fan Research Aircraft. The test was restricted entirely to an investigation of the wing-fuselage combination and as such no empennage was represented. Test objectives were slanted toward verification of previous analytical investigations with close attention paid to uncovering any transonic effects which might have been crudely represented analytically. The tests were completed to the point of achieving a 5 percent margin on equivalent speed for the highest aileron rotational frequency studied, approximately 18.9 cps. One actual case of flutter occurred, at M = 0.75 and at a dynamic pressure (q) of approximately 600 psf for an aileron rotational frequency of 14.9 cps. A second case of flutter occurred at M = 0.75 and a q greater than 600 psf for an aileron rotational frequency of 16.1 cps; however, this latter case of flutter was not considered valid due to the apparent fatiguing of an aileron spring bracket, resulting in essentially a free-floating surface. Author (TAB)

N67-22692# Boeing Co., Morton, Pa. Vertol Div.
TIP VORTEX CORE THICKENING FOR APPLICATION TO HELICOPTER ROTOR NOISE REDUCTION Final Report
Robert H. Spencer, Henry Sternfeld, Jr., and Bernard W. McCormick Sep. 1966 89 p refs
(Contract DA-44-177-AMC-215(T))
(R-403A; USAAVLABS-TR-66-1; AD-644317) CFSTI: HC $3.00/MF $0.65

Helicopter rotor noise levels are sharply increased when a rotor blade intercepts the rolled-up tip vortex trailed by a previous blade. The study deals with modification of the induced velocity structure of the vortex from both an analytical and an experimental standpoint. Ten tip configurations were evaluated in a wind tunnel, to determine the magnitude of velocity reduction achievable. Results indicated that the maximum velocities induced within the vortex core could be reduced to about 12 percent of those for a standard tip (formed by revolving the tip airfoil section about the chord-line and typical for many present generation helicopters). Drag data measured on the model wing for each blade tip indicates that most configurations adversely affect performance. Author (TAB)

N67-22704# Royal Aircraft Establishment, Farnborough (England).
A PRELIMINARY THEORETICAL STUDY OF AN ADAPTIVE MANOEUVRE DEMAND AIRCRAFT CONTROL SYSTEM USING SAMPLED-DATA TECHNIQUES
M. R. Watts Dec. 1965 31 p refs
(RAE-TR-65278; AD-479403) CFSTI: HC $3.00/MF $0.65

An adaptive controller has been studied with a view to the development of a simple maneuver demand system for high performance aircraft. The stability has been examined by means of a continuous signal approximation and some digital computer solutions for the sampled-data system are presented. Author (TAB)

N67-22705# Royal Aircraft Establishment, Farnborough (England).
SOLUTION OF THE CATAPULT TAKE-OFF PERFORMANCE EQUATIONS BY AN ANALOGUE METHOD
E. W. Addicott and R. W. Jones Jan. 1966 36 p
(RAE-TR-66026) CFSTI: HC $3.00/MF $0.65

An analog computer program was derived, making as few approximations as possible, for the calculation of the flight path of an aircraft leaving the end of a shipborne catapult. Using this complete calculation, it was shown that, for most aircraft, other approximations could be made without significantly impairing the accuracy of the result, and greatly simplifying the program. A description of both programs is given here, together with their derivation and method of use. Author

N67-22714# Royal Aircraft Establishment, Farnborough (England).
THE UNPOWERED, FREE FLIGHT, AIRCRAFT MODEL. DESIGN, OPERATION, AND INSTRUMENTATION FOR LOW SPEED STABILITY INVESTIGATIONS
D. R. Dennis Mar. 1963 30 p refs
(RAE-TN-AERO-2881) CFSTI: HC $3.00/MF $0.65

A free-flight model technique for investigating the low speed stability characteristics of aircraft in gliding flight is described. Author

N67-22737# Toronto Univ., (Ontario). Inst. for Aerospace Studies.
EFFECT OF GROUND BOARD BOUNDARY LAYER ON AIR CUSHION VEHICLE WIND TUNNEL TESTS

E. K. Garay Jan. 1967 50 p refs
(Contract AF 33(657)-8451)
(UTIAS-TN-100; AD-646808) CFSTI: HC $3.00/MF $0.65

Forward speed tests were performed on an Air Cushion Vehicle in the subsonic wind tunnel using a fixed ground board. The effect of the ground board boundary layer on the reactions of the vehicle was determined by comparing the test results with previous tethered flight tests conducted in the circular track facility. Comparisons with similar reported tests were made to extend these test results. The results did not indicate any noticeable differences between the wind tunnel and circular track results. Analysis showed that differences begin to appear as the forward speed increases and curves the leading edge jet backwards. The magnitude of the boundary layer effect on the vehicle reactions is shown to depend on the testing technique used. The suitability of low priced model aircraft engines for low budget powered model testing is demonstrated. Author (TAB)

N67-22791# Aeronautical Research Council (Gt. Brit.).
MEASUREMENTS OF "AQUAPLANING HEIGHT" ON A METEOR AIRCRAFT, AND PHOTOS OF FLOW PATTERN UNDER A MODEL TYRE
W. E. Gray Nov. 1962 11 p ref Supersedes RAE-TN-AERO-2855; ARC-24669; See N65-20510
(ARC-CP-717; RAE-TN-AERO-2855; ARC-24669) CFSTI: HC $3.00/MF $0.65

Experiments with a Meteor aircraft to measure the gap between tire and runway under high speed and flooded conditions are described. Water depths were varied from 1/8 in. to 1.0 in., and most of the tests were at 90 knots, at which speed the tire was well off the ground in 1/4 in. of water. Clearances were measured by small ridges of plasticine, and some evidence was obtained of tire distortions and of water velocity under the tire. Qualitative studies of the liquid thickness in the footprint area of a small model tire were made and photographs taken showing the flow directions and velocities under the tire. To do this the model tire was run in contact with the inner wall of a transparent drum. A selection of photographs is given. Author

N67-22796# Aeronautical Research Council (Gt. Brit.)
THEORETICAL STUDY OF THE ROLLING RESPONSE OF AIRCRAFT TO TURBULENT AIR
J. K. Zborzek Apr. 1961 44 p refs
(ARC-R&M-3423; RAE-TN-AERO-2753; ARC-23620) CFSTI: HC $3.00/MF $0.65

A method is presented for assessing the lateral responses of aircraft to continuous tubulence. The method is applied to the study of rolling behavior in turbulent air of a range of aircraft configurations. It is shown, that it is essential to include the pilots' control in this study. Estimates are given of the aileron angle required to stabilize the aircraft in turbulent air; the effects of forward speed, aircraft size, and two simple auto-stabilization systems are briefly investigated. A comparison is made between the continuous turbulence and discrete gusts approaches. It is pointed out, that there is an absolute lack of experimental data against which to check the theory. Author

N67-22864*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE FREE-FLIGHT CHARACTERISTICS AND HANDLING QUALITIES OF A GROUND-EFFECT MACHINE
Arthur W. Carter and Lee H. Person, Jr. Washington, NASA, Apr. 1967 27 p refs
(NASA-TN-D-3885) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Results indicate that the control system was generally poor and would be unacceptable for normal operations over sustained periods of time. Any inherently good handling qualities were masked by high breakout, friction and maximum control forces, excessive control free play, lack of positive control centering, and nonlinear characteristics of the control system. The use of collective deflection of the main nozzle vanes (integrated propulsion system) for propulsion or braking reduced an otherwise acceptable yaw control to an unacceptable level. The maximum forward acceleration was 0.044g when operating with the integrated propulsion system and 0.100g when the separate propulsion engine was added. Pilots' opinions indicated that the longitudinal acceleration of 0.1g was about the minimum acceptable value. The maximum rate of deceleration or braking was 0.055g which was about half of the minimum considered to be acceptable. Author

N67-22970# Brussels Univ. (Belgium). Institut d'Aeronautique.
EXPERIMENTAL VEHICLE PV-1 WITH AIR CUSHIONS. FLIGHT TEST (VEHICLE WITHOUT FLAPS) [VEHICULE EXPERIMENTAL A COUSSIN D'AIR PV-1. ESSAI EN VOL (VEHICULE SANS JUPE)]
A. Jaumotte, A. Kiedrzynski, and M. Lejuene 1966 49 p refs In FRENCH
(NT-10-1966; Rept.-3) CFSTI: HC $3.00/MF $0.65

Flight test results are listed for the PV-1 experimental air cushion vehicle. The center of gravity of the vehicle was calculated, and the aerodynamic characteristics, lift and thrust, were determined. Measurements were also made of the thrust obtained through deviation of jet, and the curves of acceleration, maximum speed, and deceleration. Transl. by R.Ll.

N67-22971# Brussels Univ. (Belgium). Institut d'Aeronautique.
ANALYSIS OF THE DISTRIBUTION OF THE PRESSURE ON THE BASE OF AIR CUSHION VEHICLES IN SMOOTH FLOW [ANALYSE DE LA REPARTITION DE LA PRESSION SUR LA BASE D'UN VEHICULE A COUSSIN D'AIR EN ECOULEMENT PLAN]
Georges Van Malder 1966 62 p refs In FRENCH
(NT-9-1966) CFSTI: HC $3.00/MF $0.65

The two-dimensional flow and pressure distribution are investigated on an air cushion vehicle. Base length, flight altitude, and length of the airfoil slot were calculated. An attempt was made to explain the deviation between theoretical and experimental results. Transl. by R.Ll.

N67-22992# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
ENERGY DEPOSITION RATES IN ZIRCALOY-2 AND GRAPHITE IN THE NRX REACTOR
A. W. Boyd and O. A. Miller Oct. 1966 12 p refs
(AECL-2632) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Energy deposition rates in Zircaloy-2 and graphite have been measured using adiabatic calorimeters in three positions in the NRX reactor. The results obtained and neutron fluxes in these positions are summarized. Author

N67-23056# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
COST AND EFFECTIVENESS EVALUATION OF AUTOMATED CARGO DELIVERY SYSTEMS IN ARMY AIRCRAFT Final Report, 10 May–11 Oct. 1966
Donald A. Andrastek, Reginald R. Belding, and James W. Wollaston Jun. 1966 214 p refs
(Contract DA-44-177-AMC-270(T))
(DAC-56004; USAAVLABS-66-34; AD-637158) CFSTI: HC $3.00/MF $0.65

In the first phase of the two-phase study, methodologies were developed to (1) measure the degree of automation of a given cargo handling system and (2) evaluate the gains and penalties resulting from automating cargo handling functions in Army aircraft

from a cost/effectiveness point of view. Basic to the study were the effects of cargo handling equipment on aircraft payload, cargo handling time, manning, aircraft availability, and vulnerability and costs. Several cargo handling systems were evaluated in the second phase of the study. These systems ranged from manual to very highly automated and were evaluated in the CV-2, CV-7, CH-47, and a hypothetical 10-ton STOL. Elements not affected by the cargo handling system were held constant whenever possible. Author

N67-23145# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPERSONIC PASSENGER AIRPLANE
I. D. Pipko 31 Oct. 1966 15 p Transl. into ENGLISH from Nauka i Zhizn (Moscow), no. 9 1965 p 34–37
(FTD-HT-66-288; TT-67-60685; AD-648293) CFSTI: HC $3.00/MF $0.65

The article gives the vital statistics of the new Soviet Supersonic Airliner, the Tupolev TU-144. Some of the problems in designing aircraft and the basic principles of flight are discussed. There is an emphasis on frontal resistance and the wing design. Author (TAB)

N67-23242*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
RECENT RESEARCH DIRECTED TOWARD THE PREDICTION OF LATERAL-DIRECTIONAL HANDLING QUALITIES
Lawrence W. Taylor, Jr. and Kenneth W. Iliff Paris, AGARD, May 1966 22 p refs Presented at 28th Meeting of the AGARD Flight Mech. Panel, Paris, 10–11 May 1966
(NASA-TM-X-59621; AGARD-531) CFSTI: HC $3.00/MF $0.65
CSCL 01D

A survey of lateral-directional handling qualities has been made for the purpose of developing a technique for predicting pilot ratings. This survey was made by obtaining pilot ratings of lateral control on a fixed-base simulator in conjunction with a color contact analog display. The effect of five lateral-directional handling qualities parameters were studied by systematically varying them over a wide range. Comparisons were made between predicted pilot ratings and those obtained in flight for several different airplanes. Although it is apparent that further extensions and improvements are needed to take into account some of the effects that were neglected in this study, such as mission, airplane type and use of rudders, it has been demonstrated that an extensive survey can be made and systematized in a way that enables it to be applied to a wide range of airplane configurations. Author

N67-23243*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
USE OF A LARGE JET TRANSPORT AS AN INFLIGHT DYNAMIC SIMULATOR
William M. Eldridge (Boeing Co., Renton, Wash.) and Harold L. Crane Paris, AGARD, 30 p Presented at the 28th Meeting of the AGARD Flight Mech. Panel, Paris, 10–11 May 1966
(NASA-TM-X-59620; AGARD-528) CFSTI: HC $3.00/MF $0.65
CSCL 01B

In order to study the low speed approach and landing characteristics of supersonic transport configurations, the original Boeing 707 prototype aircraft was modified for use as an inflight simulator. The development of the dynamic simulator is described, and discussions are presented of the use of spoilers and thrust reversers to simulate variations in lift and drag with angle of attack, the ability to vary the longitudinal characteristics to simulate the ground proximity, and the ground-based simulator and computer studies used to investigate problem areas and check simulation quality. A.G.O.

N67-23244# Systems Technology, Inc., Hawthorne, Calif.
SOME OPEN-LOOP AND CLOSED-LOOP ASPECTS OF AIRPLANE LATERAL-DIRECTIONAL HANDLING QUALITIES
I. L. Ashkenas Paris, AGARD, May 1966 71 p refs Presented at 28th Meeting of the AGARD Flight Mech. Panel, Paris, 10–11 May 1966
(Contract AF 33(657)-10407)
(AGARD-533) CFSTI: HC $3.00/MF $0.65

The usefulness of closed-loop analysis, based on a mathematical model of the pilot, to explain and predict handling qualities problems is by now fairly well established. Open-loop response characteristics to specified control or disturbance inputs have long been considered pertinent indicators of potential control difficulties. In this paper both types of analysis are used to explain, and to obtain correlating parameters for, a large body of lateral-directional handling qualities data. The study is divided into two basic parts, one dealing with "ideal" single-degree-of-freedom rolling, the other with coupled lateral-directional motions. In each area the analyses and resulting correlations yield improved understanding of the root causes of specific piloting problems and of related handling qualities requirements. Author

N67-23246# Royal Aircraft Establishment, Farnborough (England).
FLIGHT EXPERIENCE OF RATE DEMAND CONTROL USING ELECTRIC SIGNALLING IN THE AVRO 707C AIRCRAFT
G. C. Howell Paris, AGARD, May 1966 24 p Presented at 28th Meeting of the AGARD Flight Mech. Panel, Paris, 10–11 May 1966
(AGARD-536) CFSTI: HC $3.00/MF $0.65

Results are given of flight tests of a pitch and roll rate demand system using full authority electric signalling in the Avro 707C aircraft. The effect of pilot induced oscillations is considerably reduced when a miniature two-axis controller is used in place of a conventional stick—even when the response time is very short. It was found that the control of the aircraft was very natural with a miniature controller of the type described in the report and it is concluded that such a system with no mechanical revision is the only final solution to allow an optimum design to be used. Author

N67-23247# Air Force Systems Command, Edwards AFB, Calif. Advanced Vehicles Research Branch.
CORRELATION OF X-15 SIMULATION EXPERIENCE WITH FLIGHT TEST RESULTS
Robert G. Hoey Paris, AGARD, May 1966 24 p Presented at 28th Meeting of the AGARD Flight Mech. Panel, Paris, 10–11 May 1966
(AGARD-530) CFSTI: HC $3.00/MF $0.65

This paper describes the simulations used in the program and compares simulation results with actual flight test results. Flight and simulator pilot ratings are compared over a range of handling qualities from excellent to uncontrollable. Flight trajectories are presented and compared with simulator predictions. Apparent variations between simulator predictions and actual flight results are discussed as to their cause and their effect on simulation confidence. Improvements to the simulators resulting from flight test data and pilot comments are also discussed. Included is a description of a real-time simulation of aerodynamic heating and ablation, the manner in which this simulation will be used during the X-15 flight envelope expension from Mach 6 to 8, and comparison of heating simulation results with data obtained to date. Author

N67-23248# Advisory Group for Aerospace Research and Development, Paris (France).
CORROSION OF AIRCRAFT

H. G. Cole, ed. Apr. 1966 55 p Summaries and Discussions of Papers Presented at 22d Meeting of AGARD Struct. and Mater. Panel, Delft, Netherlands, 19–20 Apr. 1966
(AGARD-540) CFSTI: HC $3.00/MF $0.65

Abstracted data are presented from a symposium on aircraft corrosion which was divided into the following sections: (1) corrosion in service, (2) design to avoid corrosion, (3) inspection in service, and (4) damage and assessment. Summaries of the panel discussions following each conference presentation are also included. A.G.O.

N67-23349# Northrop Corp., Hawthorne, Calif. Norair Div.
INVESTIGATION OF LOW-LEVEL AIRCRAFT OPERATIONAL HAZARDS
Homer A. Ralles Nov. 1966 140 p refs
(Contract DA-44-177-AMC-309(T))
(USAAVLABS-TR-66-78; AD-645885) CFSTI: HC $3.00/MF $0.65

The study evaluates the obstacle impact hazards incurred by operation of Army aircraft at treetop altitudes and describes techniques useful in alleviating those hazards. The magnitude of the problem of obstacle impacts is determined by a statistical analysis of aircraft tree strikes and wire strikes to identify the significant parameters involved. Investigation of sensor techniques and aircraft operating procedures is presented to aid development of obstacle warning systems. Author (TAB)

N67-23364# Federal Aviation Agency, Washington, D. C.
EMERGENCY EVACUATION TESTS OF A CRASHED L-1649
J. D. Garner and John G. Blethrow Sep. 1966 52 p
(FAA-ADS-49; AD-645423) CFSTI: HC $3.00/MF $0.65

Four basic evacuation tests were performed on a crashed L-1649 in Phoenix, Arizona, to document problem areas, passenger reaction, emergency lighting, slope of flooring and other items affecting passenger egress. Two day and two night tests were run with different crew and passengers for each. The tests were designed to observe the reactions of the crews and passengers under different emergency conditions rather than to compare the results of one test with another. Data were collected by tape recordings, motion picture film, and questionnaires. Observations were recorded. Author (TAB)

N67-23430 Federal Aviation Agency, Washington, D. C. National Aviation Facilities Experimental Center.
AN EVALUATION OF THE HEIGHT VELOCITY DIAGRAM OF A HEAVYWEIGHT, HIGH ROTOR INERTIA, SINGLE ENGINE HELICOPTER
William J. Hanley, Gilbert De Vore, and Shirrel Martin Nov. 1966 58 p refs
(FAA-ADS-84)

A series of flight tests was conducted at three selected altitudes (sea level, 5000 feet, 6500 feet) to determine the effects of altitude and weight on the height-velocity (H-V) diagram of a large, heavyweight, high rotor inertia, high disk loading, single rotor, single engine helicopter. Three gross weights of the helicopter were used. Quantitative and qualitative test data were collected to determine how the H-V diagram varies with density altitude and aircraft gross weight. An investigation was made into the effects on the diagram of a delayed collective pitch application response. Results disclosed a family of curves showing that increases in density altitude and/or gross weight enlarged the H-V diagram required for a safe power-off landing. Analysis of the results revealed that the key points, which partially define the curves, could be determined by the solution of a set of linear equations. The critical height indicated a slight increase as weight, altitude and collective pitch reduction time delay were increased. An average value for h_{cr} can be selected without upsetting the family of curves. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-22068*# Monsanto Research Corp., Everett, Mass. Boston Lab.
RESEARCH AND DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Quarterly Report, 9 Jun.–9 Sep. 1966
John S. Driscoll, David L. Williams, and Alexander S. Borsanyi 31 Dec. 1966 58 p refs
(Contract NAS3-7624)
(NASA-CR-72170; MRB501005; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Details are given on continuing research in the development of a dry tape battery concept, including high energy couple research, tape cell preparation, and supporting research. Aqueous and nonaqueous systems were considered in relation to high energy couples, and reports are given on cathode research, energy densities, anode research, and electrolyte studies. In the area of tape cell preparation, details are given on machine-made cathodes and on tape systems with oxygen cathodes. Development of a rolling cathode current collector and a pressurized testing chamber are also described, and future plans are outlined. L.E.W.

N67-22149*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CELL CALIBRATION EVALUATION Quarterly Report, Sep.–Nov. 1966
William G. Gdula *In its* Radiometry Res. Mar. 1967 55 p
(See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65

A review of all solar cell measurements developed during this program is presented with a brief description of the theoretical, experimental, and application aspects. In addition, a series of 1 MeV electron radiation experiments were performed to define the radiation damage characteristics of silicon solar cells fabricated from 1 ohm-cm and 10 ohm-cm resistivities with thicknesses of 8 mils to 16 mils. Preliminary results of the angular dependence studies of the electron damage rate in silicon solar cells indicate a higher damage coefficient as the incident angle of the electron flux is increased. Proton damage is presently being investigated. Electron damage characteristics of lithium doped silicon solar cells, fabricated from 20 ohm-cm float-zone material, indicate 300°K annealing only partially effective in short-circuit current recovery. Degradation of the voltage characteristics remained after 15 days of annealing. Author

N67-22161*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
RESEARCH IN THE CONVERSION OF VARIOUS FORMS OF ENERGY BY UNCONVENTIONAL TECHNIQUES Status Report
Mar. 1967 129 p refs
(Grant NsG-316)
(NASA-CR-83320; INDEC-SR-11) CFSTI: HC $3.00/MF $0.65 CSCL 10A

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3. TUNNEL EMISSION COLD CATHODES S. R. Pollack and S. Basavaiah 3 p (See N67-22164 11-03)

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5. FLOW OF A CONDUCTING LIQUID IN AN ANNULAR GAP: A RESTRICTED NONEXISTENCE PROOF S. Schweitzer and I. M. Cohen 7 p refs (See N67-22166 11-25)

6. ANISOTROPY OF METAL WORK FUNCTIONS M. Kaplit 11 p refs (See N67-22167 11-26)

7. THE DESIGN OF ABSORPTION TOWERS DISSOLVING H_2 AND O_2 IN AQUEOUS KOH 27 p refs (See N67-22168 11-03)

8. OVERPOTENTIAL-TIME VARIATION FOR GALVANOSTATIC CHARGING WITH POTENTIAL DEPENDENT CAPACITANCE L. Nanis and P. Javet 4 p refs (See N67-22169 11-03) 11-03)

9. CURRENT AND POTENTIAL DISTRIBUTION IN CYLINDRICAL GEOMETRIES: ENGINEERING APPLICATIONS TO FUEL CELL DESIGN L. Nanis 9 p refs (See N67-22170 11-03)

10. FOAMING ELECTROLYTE FUEL CELL L. Nanis and A. Saunders 5 p (See N67-22171 11-03)

N67-22164*# Pennsylvania Univ., Philadelphia.
TUNNEL EMISSION COLD CATHODES
S. R. Pollack and S. Basavaiah *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 3 p (See N67-22161 11-03) CFSTI: HC $3.00/MF $0.65

The performance characteristics of the vacuum chamber, and preliminary experiments in sample preparation are reported. Pure refined tungsten was evaporated on glass substrate, tungsten film was oxidized by plasma oxidation, and gold films were evaporated onto the oxidized tungsten film. The first set of characteristic data is included. N.E.N.

N67-22168*# Pennsylvania Univ., Philadelphia.
THE DESIGN OF ABSORPTION TOWERS DISSOLVING H_2 AND O_2 IN AQUEOUS KOH
In its Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 27 p refs (See N67-22161 11-03) CFSTI: HC $3.00/MF $0.65

The feasibility of an absorption system integrated with the operation of a fuel cell was investigated, and the size flow and power consumption characteristics of the towers are described for the absorption system which saturates a 4N KOH electrolyte solution with oxygen and hydrogen. The design specifications, variables, equation derivations, and physical data are outlined. The oxygen and hydrogen towers are discussed briefly, and the design parameters and pumping requirements are summarized. N.E.N.

N67-22169*# Pennsylvania Univ., Philadelphia.
OVERPOTENTIAL-TIME VARIATION FOR GALVANOSTATIC CHARGING WITH POTENTIAL DEPENDENT CAPACITANCE
Leonard Nanis and Phillippe Javet *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 4 p refs (See N67-22161 11-03) CFSTI: HC $3.00/MF $0.65

The nonlinear differential equation for the time variation of over-potential during galvanostatic charging is solved by introducing a close approximation for the second term of rate equation. The results obtained are in close agreement with known solutions, covering all values of transfer coefficient, and are simple in form. Further, the incorporation of potential dependent capacitance is readily accomplished. Computations for such cases are shown to have a considerable effect on the overpotential transient. Author

N67-22170*# Pennsylvania Univ., Philadelphia.
CURRENT AND POTENTIAL DISTRIBUTION IN CYLINDRICAL GEOMETRIES: ENGINEERING APPLICATIONS TO FUEL CELL DESIGN
Leonard Nanis *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 9 p refs (See N67-22161 11-03) CFSTI: HC $3.00/MF $0.65

A mathematical analysis using electrical field problem solutions, especially the concept of partial resistance, is presented for the fuel cell design in which the electrolyte is held in a matrix or membrane. Cylindrical geometry was chosen since screen contact impressions with a matrix are generally circular. The entire potential space field as a solution to the Laplace equation was evaluated for the conducting disk located at the bounding plane of a semi-infinite space filled with electrolyte. Illustrations of the disk at constant potential and of constant current density on the disk are given. N.E.N.

N67-22171*# Pennsylvania Univ., Philadelphia.
FOAMING ELECTROLYTE FUEL CELL
L. Nanis and A. Saunders *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 5 p (See N67-22161 11-03) CFSTI: HC $3.00/MF $0.65

A system in which solution of fuel gas into the electrolyte is accomplished from a foam structure supported by the reactant gases is discussed, and data on foaming agents used with concentrated KOH are presented. Readily available foamants were tested, their performances are given, and the most promising is indicated. Improvement in the current–voltage curve was obtained by flowing a gas in each compartment at a rapid rate, and cell resistance was increased by lifting the platinum electrodes clear of the electrolyte. It was felt that a very stable foam is not as desirable as one which soaks up hydrogen and oxygen. N.E.N.

N67-22177*# Livingston Electronic Corp., Montgomeryville, Pa.
LOW TEMPERATURE BATTERY Quarterly Reports, 14 Mar.–13 Sep. 1966
George M. Armstrong 13 Sep. 1966 117 p
(Contract NAS3-8503)
(NASA-CR-72172; QR-2; QR-3) CFSTI: HC $3.00/MF $0.65
CSCL 10C

The system, $Mg/KSCN–NH_3/HgSO_4$:S, was studied in both prismatic and bobbin type cells for the purpose of achieving 72 hour operation over a temperature range of +20° to −90°C. A discharge cycle of 0.3 watts for 54 minutes and 1.5 watts for 6 minutes is required for each hour. This 72 hour goal has been exceeded at −90°C in both cell configurations with $HgSO_4$:S:C and with S:C cathodes. A prismatic cell with a S:C cathode also performed well at −63°C. In the bobbin structure, both types of cathodes exhibited the capability of satisfactory performance throughout a temperature range of −40° to −90°C. However, the formulation containing $HgSO_4$ was much superior to the one having only sulfur and carbon. A self-contained cell in full hardware was built and tested. Its performance at −73°C was satisfactory. Author

N67-22397# Naval Research Lab., Washington, D. C.
CHANGING THE DISCHARGE CAPACITY OF A SILVER OXIDE ELECTRODE BY CHARGING WITH PERIODICALLY INTERRUPTED CURRENT
C. P. Wales 19 Oct. 1966 21 p refs
(NRL-6460; AD-644616) CFSTI: HC $3.00/MF $0.65

Sintered silver electrodes were oxidized anodically in 35% to 50% KOH at 25C, usually at the 20-hr rate, sometimes at faster rates. Length of charge plus open-circuit periods varied from 8 hr to 1/60 sec. A particular charge length and open-circuit length was repeated until oxygen evolution occurred. In 50% or 45% KOH this charge method gave either the same capacity as a constant dc charge or less capacity, but in 35% KOH the

improvements averaged as high as 40% under certain conditions. Best results were obtained when the preceding discharges were at low rates. Author (TAB)

N67-22466# Aeronautical Research Lab., Melbourne (Australia).
A SOLID STATE HIGH VOLTAGE DYNAMIC FILTER
D. C. Cocks Dec. 1965 12 p
(ARL/FL-39) CFSTI: HC $3.00/MF $0.65

The performance of an electrodynamic vibration calibrator at low acceleration levels has been greatly improved by incorporating a dynamic filter in the dc field coil power supply, thereby effecting a reduction, by a factor of 600, in the ripple component of the field current. Author

N67-22468# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
ELECTROCHEMICAL NUCLEAR ENERGY CONVERTER [ELEKTROCHEMISCHE KERNENERGIE-KONVERTER]
G. Grueneberg Jan. 1964 48 p refs In GERMAN; ENGLISH summary
(JUL-144-PC) CFSTI: HC $3.00/MF $0.65

Available information on electrochemical methods is reviewed. In these processes the nuclear energy is primarily converted into chemical energy. The radiation products are used in especially adapted galvanic cells. An important example is the consumption of H_2–O_2 gas mixtures developed by water moderated nuclear reactors in H_2–O_2 fuel cells. Using the results of radiochemical investigations an estimation of the conversion efficiency of the different electrochemical methods is possible. The regenerative oxygen–ozone cell with an efficiency factor of 15 to 25 percent should be of special technical interest. The regenerative hydrogen–ferric ion cell is also competitive with physical conversion methods. The possible use of a U-235 homogeneous reactor as a galvanic cell is briefly discussed. Author

N67-22469# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
ELECTROCHEMICAL HEAT CONVERTER [ELEKTROCHEMISCHE WAERMEKONVERTER]
G. Grueneberg Apr. 1964 31 p refs In GERMAN; ENGLISH summary
(JUL-170-PC) CFSTI: HC $3.00/MF $0.65

Details are given on electrochemical methods for converting heat into electricity. These include (1) the use of a periodical temperature change in special galvanic cells; (2) the reaction product of the galvanic element which is regenerated into the reactive components by thermic decomposition outside the electrochemical system; (3) the aqueous electrolyte of concentration cells regenerated by thermic fractionation outside the electrochemical system; and (4) the use of electrodes of the electrochemical system at different temperatures. Typical examples are given to describe each method. The advantages and disadvantages of the physical and electrochemical processes are assessed. Author

N67-22471 Atomic Energy Centre, Lahore (Pakistan).
SOLAR ENERGY—A BIBLIOGRAPHY OF SELECTED LITERATURE
M. M. Rafique, F. A. Afzal, and M. Saleem Sep. 1966 83 p refs
(AECL-Pak/Library/15) CFSTI: HC $3.00/MF $0.65

References to unclassified reports and published literature are presented on the subject of solar energy. Major areas of interest covered include cells, collectors, converters and concentrators, economics, energy source of the future, measurements, space applications, stills, and pumps, power, and mechanical engineering. Abstracts are included for most of the references. L.E.W.

N67-22686# Bowles Engineering Corp., Silver Spring, Md.
APPLICATION OF FLUIDICS TO AUTOMATIC FLIGHT CONTROL
E. M. Dexter S. D. Wills, C. V. Di Camillo, L. A. Kaufman, and C. Van Dusen (Kaman Aircraft Corp.) Sep. 1966 207 p refs
(Contract DA-44-177-AMC-202(T))
(USAAVLABS-TR-66-71; AD-645759) CFSTI: HC $3.00/MF $0.65

The report evaluates the feasibility and desirability of a fluidic Automatic Flight Control System. The study is carried out in four parts: (1) a description of the basic flight control system and fluidic components; (2) the definition and requirements for an automatic flight control; (3) a proposed fluidic system; and (4) an evaluation of the proposed system with a comparison with an existing Automatic Flight Control System. The Automatic Flight Control System (AFCS) to be implemented consists of open loop damping (OLD) systems, stability augmentation systems (SAS) and an autopilot. Each mode of control - pitch, yaw, roll, and translation - is similar in function. The portion of the complete AFCS chosen for implementation is the pitch axis of a fly-by-wire system. For the Fluidic system under consideration in this report, a fluid signal transmission system is the equivalent of the conventional fly-by-wire system. The proposed fluidic control has hydraulic OLD and SAS, and a pneumatic autopilot. These fluids were chosen primarily for compatibility with the power drive and response, respectively. The reliability comparison, which for the fluidic components was based on estimated failure rates, shows better performance for the fluidic system. TAB

N67-22712# Royal Aircraft Establishment, Farnborough (England).
CONTINUOUS CHARGE–DISCHARGE CYCLING STUDIES ON HERMETICALLY SEALED NICKEL–CADMIUM CELLS OPERATING AT A 10 PERCENT DEPTH OF DISCHARGE
P. G. Garratt and S. E. A. Pomroy Feb. 1966 23 p refs
(RAE-TR-66045) CFSTI: HC $3.00/MF $0.65

Hermetically sealed nickel–cadmium cells are being subjected to continuous charge–discharge cycling studies in order to investigate their performance at various temperatures and depths of discharge. This report covers one year of cycling, which simulates the maximum dark period conditions (10% depth of discharge) predicted for the U.K.3 satellite. No cell failures have been observed over the temperature range −10° C to 50° C during the first 6000 cycles. Cell performance studies showed some deterioration in cells cycled at 40° C and 50° C, although their performance under charge–discharge cycling was not noticeably affected. Author

N67-22854*# Aerojet-General Corp., Azusa, Calif.
RELIABILITIES OF REDUNDANT ELECTRICAL GENERATOR SYSTEMS
B. L. Amstadter 9 Mar. 1964 14 p
(NASA-CR-72208; TM-343-64-3-215) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The objectives, conclusions, and methodology of a reliability study of various redundant configurations of electrical generating systems are summarized. Two general redundancy types are considered: active-parallel and sequential. Applicable equations are defined, and the numbers of units required to provide 35 kw of power with various degrees of reliability are calculated. Several relatively equivalent options are presented for achieving each level of reliability. Author

N67-22946# Gt. Brit. Ministry of Aviation, London.
THE AUTOMATIC CHARGING OF UNSPILLABLE LEAD ACCUMULATORS [DAS AUTOMATISCHE LADEN ELEKTROLYTDICHTER BLEI-AKKUMILATOREN]
H.-G. Beier and H. Richt Dec. 1966 10 p Transl. into ENGLISH from Funkschau Rept. (Germany), v. 1, 1965
(TIL/T-5697) CFSTI: HC $3.00/MF $0.65

Requirement of automatic chargers for this type of cell, using jellified acid, are summarized, then the charger itself is described and modifications of it. Author

N67-23024# Kernforschungsanlage, Juelich (West Germany). Arbeitsgruppe Institut fuer Technische Physik.
THE THERMIONIC DIODE AS DIRECT CONVERTERS OF HEAT INTO ELECTRICAL ENERGY [DIE THERMIONISCHE DIODE ALS DIREKTUMWANDLER VON WAERME IN ELEKTRISCHE ENERGIE]
Ernst A. Niekisch and Eduard Preuss Apr. 1965 35 p refs In GERMAN
(JUL-262-TP) CFSTI: HC $3.00/MF $0.65

After a brief description of thermionic processes in a diode, involving electron condensation on the colder of two electrodes and the creation of a thermal current, various calculations were performed on diode parameters for optimization of the energy output. Emphasis was placed on the development of a thermionic converter that utilizes nuclear energy to heat its cathode. The included literature review covers high vacuum materials, able to resist high temperatures and cesium environment, and their possible application in diode construction. Transl. by G.G.

N67-23038 Atomic Energy Center, Lahore (Pakistan). Electronics Div.
RURAL ELECTRIFICATION, A GENERAL REPORT
F. A. Afzal Mar. 1966 23 p
(PAECL/SOL-3) CFSTI: $3.00

A discussion is given of the electrification of rural homes in Pakistan by utilizing solar cells and storage batteries. Included in the discussion are topics devoted to the merits, disadvantages, technical details, and economical feasibility of the system. C.T.C.

N67-23070# Bowles Engineering Corp., Silver Spring, Md.
COMPONENTS FOR FM AND AM FLUIDIC CIRCUITS
Ronald E. Bowles and Edwin M. Dexter [1967] 16 p Presented at the 2d Cranfield Fluidics Conf., Cambridge, England, 3–5 Jan. 1967 *Its* Paper D5
CFSTI: HC $3.00/MF $0.65

Fluidic systems have many of the same problems of their electronic counterparts. Solutions to these problems in fluidic systems may take the same basic approaches as in electronic systems. Improvement in stability, drift, and self-noise in fluidic systems is being approached through carrier systems using FM and AM techniques. Author

N67-23071# British Hydromechanics Research Association, Cranfield (England).
A COMPARISON OF FLUID DIODES
P. J. Baker [1967] 28 p refs Presented at the 2d Cranfield Fluidics Conf., Cambridge, England, 3–5 Jan. 1967 Sponsored by United Kingdom Atomic Energy Authority *Its* Paper D6
CFSTI: HC $3.00/MF $0.65

A comparative study of three types of fluid diodes operating on entirely different principles is presented. Particular emphasis has been placed upon correlating the performance defined as the ratio of the pressure drop in reverse-flow direction to the pressure drop in the forward-flow direction under steady-state conditions over a range of Reynolds numbers. The results of geometrical modifications made to these three diodes in order to improve their performance are also reported. Author

N67-23079# Sheffield Univ. (England).
CHARACTERISTICS OF VORTEX DEVICES
J. K. Royle and M. A. Hassan (Univ. of Eng. and Technol., Lahore, India) [1967] 16 p Presented at the 2d Cranfield Fluidics Conf., Cambridge, England, 3–5 Jan. 1967 *Its* Paper D4
CFSTI: HC $3.00/MF $0.65

The vortex unit is simple to understand in qualitative form but there exists a lack of adequate theory and experimental fact necessary for the full exploitation of the device. In the paper, the vortex sink is studied analytically and used as a basis for examining experimental results. It is shown that the unit can be an extremely sensitive pressure amplifier and that the noise associated with vortex amplifiers can almost certainly be attributed to the unstable nature of the flow after the exit nozzle. For liquids a switch with a high impedance in one leg can readily be made by adding a Coanda switch and pitot pickup to the vortex unit. Author

N67-23080# British Aircraft Corp., Stevenage (England).
A FLUIDIC DIGITAL DISPLACEMENT INDICATOR
G. C. Gant [1967] 12 p Presented at the 2d Cranfield Fluidics Conf., Cambridge, England, 3–5 Jan. 1967 *Its* Paper E1
CFSTI: HC $3.00/MF $0.65

Various fluidic systems for determining a rectilinear displacement to an accuracy better than 0.001" are considered and details given of some experimental work on a chosen system. Emphasis is placed on the displacement transducer and its associated fluidic logic circuitry the readout being by conventional electronic means activated by fluid/electric switches. Applications envisaged for the device include inexpensive cutting tool position indication, in-process measurement and post-process inspection. Author

N67-23083# Royal Aircraft Establishment, Farnborough (England).
POWER ANGLE REGULATION FOR SYNCHRONOUS MACHINES [POLRADWINKELREGELUNG FUER SYNCHRONMASCHINEN]
D. Ernst and H. Waldmann Nov. 1966 22 p refs Transl. into ENGLISH from Elektrizitaetswirtschaft (Frankfurt), v. 64, 1965 p 121–127
(RAE-LIB-TRANS-1192) CFSTI: HC $3.00/MF $0.65

With the help of a power angle regulator, it is possible to make greater use than before of a synchronous machine in the under-excited range, without endangering the stable parallel operation with the power supply. By means of modern control and excitation techniques, a satisfactory power angle regulator can be constructed in combination with a voltage or other control device. Tests have confirmed the good operational qualities of the power angle regulator. Author

N67-23167# Army Electronics Labs., Fort Monmouth, N. J.
GALVANOSTATIC VOLTAGE TRANSIENTS OF MAGNESIUM ANODES
Gabriel J. Di Masi Sep. 1966 16 p refs
(ECOM-2763; AD-646173) CFSTI: HC $3.00/MF $0.65

The voltage transient of the magnesium anode has been studied in 2 N and 6 N Mg(ClO4)2, MgBr2 and MgCl2. In 6 N Mg(ClO4)2 the transient does not occur when a current is applied. In all other cases the transient polarization (delta V sub max) increased with increased applied current, but the transient time decreased. However, one exception is that in 2 N MgCl2 delta V sub max increases with current, but the transient time remains fairly constant. The effects of pretreating the electrode with a constant anodic current prior to pulsing have also been studied. Author (TAB)

N67-23280*# Atomics International, Canoga Park, Calif.
RADIATION EFFECTS OF SILVER AND ZINC BATTERY ELECTRODES Final Report, Apr. 1965–Oct. 1966

M. M. Nicholson, H. L. Recht, and G. R. Argue 30 Jan. 1967 50 p refs
(Contracts NAS7-100; JPL-951109)
(NASA-CR-83552; AI-67-7) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Effects of gamma radiation were investigated in experimental cells containing 40% potassium hydroxide electrolyte. Cells were examined at radiation doses of 7×10^7 to 9×10^8 rads (H_2O) for changes in discharge capacity, gas evolution, and loss of electrode material. For the silver electrodes, pressure increases up to 0.8 atm, due primarily to the radiolytic evolution of hydrogen and oxygen, were observed at the same dose level in silver test cells with cadmium counter electrodes. Material losses from unsupported silver–silver oxide electrodes in flooded cells averaged 1.4% of the silver electrode weight. An apparent increase in zinc discharge capacity during irradiation probably was caused by changes in the physical characteristics of the cellophane separator. Hydrogen evolution also occurred in zinc cells. Solid material losses were not directly measurable in the closely-packed starved-electrolyte design. Only gas evolution appears to present a special design requirement for silver–zinc batteries in space applications. Author

N67-23313*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY STUDY OF ROTATING BOILER FOR HIGH-PERFORMANCE RANKINE CYCLE POWER GENERATION SYSTEMS
Vernon H. Gray Washington, NASA, 1967 15 p For presentation at the Intersoc. Energy Conversion Conf., Miami Beach, Fla., 14–17 Aug. 1967
(NASA-TM-X-52281) CFSTI: HC $3.00/MF $0.65 CSCL 13A

A small-scale experimental study of the feasibility of a rotating boiler was undertaken using water as test fluid. Rotational accelerations up to 500 gravities were investigated. High speed photographs of the boiling fluid were taken and heat-transfer coefficients were obtained. The tests demonstrated several advantages of rotating boilers, chiefly: stable interface between liquid and vapor, high exit vapor quality, high heat flux rates, and freedom from gravity field and orientation. A concept for heating a rotating boiler with a liquid flowing in a surrounding annulus is discussed. Advantages and problems with this application are considered using an example of a boiler rotating at 14,000 rpm. R.N.A.

N67-23316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDIES OF CAVITATION DAMAGE IN ALKALI METAL PUMPS FOR APPLICATION IN SPACE POWER SYSTEMS
Cavour H. Hauser Washington, NASA, 1967 25 p refs For presentation at the Symp. on Testing Tech. in Ship Cavitation Res., Trondheim, Norway, 31 May–2 Jun. 1967
(NASA-TM-X-52286) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Some of the results to date of studies of cavitation damage in pumps are reviewed and summarized. These include tests using the magnetostrictive cavitation damage apparatus, an investigation of cavitation damage in an axial flow pump stage in liquid sodium, an investigation of cavitation damage in a mixed flow impeller in liquid potassium, and an analysis of fluid property effects on cavitation damage. The relative damage resistance of several materials was evaluated and some insight gained on material properties controlling damage. In an axial flow stage, damage from tip clearance cavitation in liquid sodium was avoided by confining the cavitation formation to the midchannel region so that it did not collapse on the blade surface. Cavitation damage in the low pressure entrance region of a mixed flow impeller pumping liquid potassium was negligible because the physical properties of the fluid in this region caused the vapor bubbles to collapse with less violence. Cavitation in the high pressure region of this impeller caused severe damage. Results to date are encouraging and it should be possible to design lightweight pumps for space power systems. R.N.A.

N67-23332*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HYDRAULIC AXISYMMETRIC FOCUSED-JET DIVERTERS WITH PNEUMATIC CONTROL
Fabio R. Goldschmied (Utah Univ.) and Michael A. Kalange 15 Dec. 1966 31 p refs
(NASA-TM-X-53554) CFSTI: HC $3.00/MF $0.65 CSCL 13G

In the fluidic technology hydraulic amplifiers are badly needed in the large flow [0.05 to 5 m^3/s (800 to 80,000 GPM)] and moderate pressure [30 to 200 N/cm^2 (45 to 300 psi)] class. The axisymmetric focused-jet amplifier is particularly suited for this application and has had considerable development for pneumatic digital control applications. One development goal was to switch a liquid stream ON and OFF in very short time periods and without devastating water-hammer. A second goal was to eliminate moving or deflecting mechanical parts. A third goal was to provide a fluidic interface between a pneumatic logic circuit [2 to 10 N/cm^2 (3 to 15 psi) air pressure] and the hydraulic power amplifier. Supply pressures up to 27 N/cm^2 (40 psi) and supply flows up to 0.010 m^3/s (160 GPM) have been employed in the test of a model diverter. Pressure recoveries and power efficiencies of the order of 50 percent have been achieved. A standing cavitation bubble is formed within the control cavity of the amplifier; thus it is possible to switch the flow with a pneumatic input without mechanical interface. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-22097# Federal Aviation Agency, Oklahoma City, Okla.
ADAPTATION TO VESTIBULAR DISORIENTATION. III: INFLUENCE ON ADAPTATION OF INTERRUPTING NYSTAGMIC EYE MOVEMENTS WITH OPPOSING STIMULI
W. E. Collins Sep. 1966 9 p refs
(AM-66-37) CFSTI: HC $3.00/MF $0.65

Failure of adaptation of nystagmic eye movements to occur under certain conditions of stimulation by angular acceleration has been ascribed to a failure to allow the eye-movement response to run its course. Three groups of subjects were tested under conditions of repeated angular accelerations in which Group A received unidirectional stimulation, Group B received bidirectional stimulation with both responses allowed to run their course, and Group C received bidirectional stimulation but the response in one direction was interrupted. Adaptation occurred for all groups in spite of the different test procedures. Other implications of the results are discussed. Author

N67-22161*# Webb Associates, Yellow Springs, Ohio.
BIO-THERMAL RESPONSES TO VARIED WORK PROGRAMS IN MEN KEPT THERMALLY NEUTRAL BY WATER COOLED CLOTHING
Paul Webb and James A. Annis Washington, NASA, Apr. 1967 70 p refs
(Contract NASw-1306)
(NASA-CR-739) CFSTI: HC $3.00/MF $0.65 CSCL 06S

During periods of heavy work, such as those expected in extra-vehicular activity, metabolic heat can be removed at nearly

any reasonable rate with water cooled clothing. We have studied the cooling needed for various work levels up to 15 kcal/min (3600 Btu/hr), using five different programs of activity over 3 to 6-hour periods. With thermally isolated subjects, and using a fixed water flow rate of 1.5 lpm (3.3 lbs/min), we adjusted water inlet temperatures so that the men neither sweated nor became chilled. Experimental data show continuous curves for "Q" (quantity of heat removed), water inlet temperature, oxygen consumption, rectal temperature, and mean skin temperature. Mean body temperature is held nearly constant, and the subjects are "comfortable" throughout the experiments. From such data one can specify control of cooling for any reasonable level of work and for many patterns of work. Author

N67-22222*# Aeronutronic, Newport Beach, Calif. Space and Re-entry Systems Div.

AUTOMATED BIOLOGICAL LABORATORY SOIL SAMPLING STUDY Final Report, 17 Feb. 1966–17 Feb. 1967

Wilfred H. Bachle 17 Feb. 1967 301 p refs

(Contract NASw-1065)

(NASA-CR-83516; UG-3962) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Conceptual design, breadboard fixture, and engineering prototype development phases are described for a sample handling system capable of acquiring, transporting, processing, and transferring small particulate samples to the analytical instruments to be used within the Voyager-class capsule configurations in the 1970's. The prototype systems are both horizontally and vertically deployed sampling systems. The former consists of a rotating brush deployed on a telescoping boom containing a combined pneumatic and mechanical transporting and collection mode. Transfer can be made by gravity drop stages and/or omnidirectional pneumatic tubes or helical screw conveyors. The vertical system is a rotating conical sieve that is dumped by rapid spinning and vibration caused by eccentric weight. Both samplers can acquire and transport particulate samples weighing one gram or more from soils that are firmly cemented, loose rubble, sand, or compacted silt. M.W.R.

N67-22303# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

DATA USED IN HEALTH PHYSICS CONSIDERATIONS FOR PLUTONIUM AND AMERICIUM

E. A. Putzier 23 Nov. 1966 40 p refs

(Contract AT(29-1)-1106)

(RFP-795) CFSTI: HC $3.00/MF $0.65

Data used in health physics considerations of Pu and Am are summarized. The nuclear constants of ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, and ^{237}U are presented. Data are included on the γ dose rates from semi-infinite thick pure metal slabs of ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu plus the daughters ^{241}Am and ^{237}U, surface dose rates from x and γ rays from ^{241}Am growth, surface dose rates from γ rays from ^{237}U growth; the effects of the decay of ^{241}Pu to ^{241}Am and ^{237}U on on the x and γ activity of a mixture of Pu isotopes; neutron radiation values (ngs) for ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{242}Pu; methods used to express the growth of ^{241}Am from ^{241}Pu; the amounts and energies of fission product impurities (^{103}Ru–^{103}Rh and ^{95}Zr–^{95}Nb) associated with Pu operations; the γ shielding properties of various materials, including Pb glass, Pb gloves, safety glass, plexiglass, Pb, and steel; data useful for calculating the isotopic abundance and radiation dose from Pu during shipment; data used in monitoring work areas for α and β activity associated with Pu isotopes; and data used to calculate the body burden from inhaled particles of Pu or Pu-contaminated wounds. NSA

N67-22312# Oak Ridge National Lab., Tenn.

THE MOLECULAR ANATOMY OF CELLS AND TISSUES: THE MAN PROGRAM Annual Report, Jul. 1, 1965–Jun. 30, 1966

N. G. Anderson Nov. 1966 99 p refs

(Contract W-7405-ENG-26)

(ORNL-3978, Spec.) CFSTI: HC $3.00/MF $0.65

The Molecular Anatomy (MAN) Program is concerned with the development of tools for the dissection and analysis, down to the molecular level, of cells and tissues. The following questions are asked: If available separation methods are extended to the limits of experimental resolution, would they resolve the complex mixture that is the cell? Given a complete molecular scan of cell contents in health and in disease, would differences due to an underlying malfunction be evident? What specific systems remain to be developed before a reasonably complete description of the molecular anatomy of a cell may be written? This report analyzes some aspects of these questions, describes analytical systems being developed under the program, and presents results of various bioseparations. Two new zonal centrifuge rotors, B-XIV and B-XV, are described in detail, together with studies on the application of these rotors to particle isolation. Both rotors allow large-volume rate-zonal and isopycnic-zonal centrifugation to be done in conventional preparative ultracentrifuges. In addition, a computer method has been developed for calculating the radial distance from the center of the rotor for a specific volume, and improvements have been made to other B Series rotors. A series of rotors is being designed and tested for large-scale virus isolation and other purposes by use of the continuous-flow principle. The prototype K-I rotor operates in the conventional air-driven Sharples machine. The large-volume (<10 liters/hr) K-II rotor is the first of several rotors that are being designed to do specific tasks. Direct motor drive or an air turbine will probably be the most economical method of spinning a production model of the K-II rotor. Advanced concepts, such as high-speed drive systems and magnetically suspended rotors, are being explored. Materials requirements are stringent for systems in these categories because of extremely high g forces. From experimental separations with several rotors, results with a number of materials are reported: lysosomes, human breast tumors, and natural waters. High-performance chromatographic systems are being modified and refined. A laboratory model of an automated carbohydrate analyzer is described, together with results of experiments in following changes in soluble carbohydrates of synchronized Tetrahymena and in assaying sugars of human urine. Ultraviolet-absorbing components of urine were chromatographically separated with a modified nucleotide analyzer. From a group of supporting studies, the following is reported: (1) physical properties of potassium citrate solutions, (2) design and testing of dialysis equipment and density indicator beads, (3) stress and corrosion tests in sodium perchlorate, and (4) determination of carbon in liquid streams or solid samples with a flame-ionization analyzer. This program is cosponsored by the National Cancer Institute and the U.S. Atomic Energy Commission. Author (NSA)

N67-22326# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. Dept. of Aerosol Physics.

EVALUATION OF PARTICLE SIZING TECHNIQUES; COMPARISON OF COMPUTER PARTICLE SIZING PROGRAMS Technical Progress Report

S. Posner, H. J. Ettinger, O. R. Pratt, Jr., and R. Moore Jul. 1966 16 p refs

(Contract AT(29-2)-1013)

(LF-30) CFSTI: HC $3.00/MF $0.65

Aerosol sampling and sizing techniques from several different laboratories were compared in Part I of the evaluation. Results from the participants agreed within ±10% in defining count median diameter and geometric standard deviation. These were obtained via hand calculation of the data. Part II deals with comparing the same, or similar, data by computer programs. Four of these

programs for analyzing particle size data are compared, and resulting differences are statistically evaluated. Author (NSA)

N67-22356*# Mayo Clinic, Rochester, Minn.
STUDIES OF THE EFFECTS OF ACCELERATION ON CARDIOVASCULAR AND RESPIRATORY DYNAMICS Semiannual Status Report
Earl H. Wood and John H. Reed, Jr. 1 Apr. 1967 25 p refs
(Grant NsG-327)
(NASA-CR-83323) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A model of the pulmonary circulation is presented which is based on data from isolated lung preparations and is supported by the use of radioactive gas studies in man. The former have the disadvantage that they are non-physiological, and the latter have the disadvantage that there are large errors in counting and correcting scan data to provide a measure of the flow per unit volume of lung. Data are presented from intact dogs studied in the right lateral position. The results of the studies indicate that the distribution of regional blood flow to the lungs is not a simple function of the differences in various vascular and airway pressures. It appears highly probable that regional differences in pleural pressures present in the intact thorax, which are weight dependent and hence determined by the direction and magnitude of resultant inertial and gravitational force vectors, play an important role as a determinant of blood flow to different regions of the lung. Author

N67-22380*# California Univ., Berkeley. Space Sciences Lab.
CHEMISTRY OF LIVING SYSTEMS Semiannual Report, 1 Oct. 1966–31 Mar. 1967
Thomas H. Jukes 31 Mar. 1967 26 p refs *Its* Space Sci. Lab. Ser. no. 8, Issue no. 24
(Grant NsG-479)
(NASA-CR-83321) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Subdivision and reconstitution of ribosomes, evolution of enzyme systems in pseudomonas, and the molecular mechanism in the assembly of the T4 bacteriophage from its protein units to form an infective organism were investigated along with other studies related to the chemistry and evolution of living systems. Consideration is given to protein synthesis during the early stage of germination of *B. subtilis*, and a sequential study of spinach ferredoxin is reported. Optical rotatory dispersion, X-ray scattering, and birefringence of DNA and RNA were investigated, as were the regulation of deoxyribose metabolism in *E. coli*, the ribonucleoside triphosphate binding site, and base sequences in TMV–RNA. M.W.R.

N67-22429# Oak Ridge National Lab., Tenn.
HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING JUL. 31, 1966
Oct. 1966 309 p refs
(Contract W-7405-ENG-26)
(ORNL-4007) CFSTI: HC $3.00/MF $0.65

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4. RADIATION DOSIMETRY J. A. Auxier p 171–210 refs (See N67-22433 11-04)
5. INTERNAL DOSIMETRY W. S. Snyder p 211–241 refs (See N67-22434 11-04)
6. HEALTH PHYSICS TECHNOLOGY B. R. Fish p 243–267 refs (See N67-22435 11-04)

N67-22430# Oak Ridge National Lab., Tenn.
RADIOACTIVE WASTE DISPOSAL
F. L. Parker *In its* Health Phys. Div. Oct. 1966 p 1–41 refs (See N67-22429 11-04) CFSTI: HC $3.00/MF $0.65

Continuing studies of the field plots show a reduced rate of loss of ^{137}Cs in the fall and winter months of the second year. There is a logarithmic relationship between ^{137}Cs loss and the soil loss. Mass balance analyses do not provide a satisfactory accounting of the total ^{137}Cs applied to the clipped meadow plot. Studies of the selective adsorption of cobalt by layer lattice silicates show that adsorption is influenced by the method of sample preparation. With identical sample preparation techniques, trioctahedral lattices sorb more cobalt than comparable minerals with dioctahedral lattices. The most probable failure mechanisms limiting the ultimate capacity of the shale formation in the hydraulic-fracturing waste-disposal method appear to be related to the stresses induced in the rocks surrounding the injection by the injection itself. The problem of defining the number and size of injections required to produce a failure condition and examination of the nuclide retention properties of the set grouts, especially those containing low-cost fly ash, continued. Final preparations for Project Salt Vault were completed. NSA

N67-22431# Oak Ridge National Lab., Tenn.
RADIATION ECOLOGY
S. I. Auerbach *In its* Health Phys. Div. Oct. 1966 p 43–119 refs (See N67-22429 11-04) CFSTI: HC $3.00/MF $0.65

Examination of salivary gland chromosomes of 755 larvae from populations of Chironomous collected from White Oak Creek and White Oak Lake which had been exposed to an estimated radiation dose of 230 rads/yr for over 120 generations revealed 12 different aberrations not found in nonirradiated insects. The effects of γ radiation on viability, interspecific competition, and mutation induction were studied in laboratory populations of Drosophila. The major activation products in soil samples exposed to 2056 rads of fast neutrons were identified as ^{56}Mn, ^{51}Cr, ^{86}Rb, ^{181}Hf, and ^{95}Zr–^{95}Nb. The effects of fast neutrons (505 and 1011 rads) on the uptake of ^{65}Zn and growth of three-year-old red oak seedlings were studied. The translocation of radioisotopes in predator–prey systems was studied using ^{134}Cs-labeled brown crickets (Acheta) as the prey and a praying mantis (Tenodera), a centipede (Otocryptops), and lycosid spiders as predators. Results demonstrated a high accumulation of ^{134}Cs by predators during the feeding process. An aerial photographic technique using infrared color photographs made with camouflage detection film and taken at a scale of 1:3960 proved efficient for the identification of insect-infested trees and timber types in forests infected with the southern pine beetle (Dendroctonus). Results are reported from measurements of the content of Cs, K, and ^{137}Cs in the flesh of fish collected monthly from the Clinch River and the content of ^{137}Cs, ^{60}Co, and ^{90}Sr in fish and periphyton in White Oak Lake. NSA

N67-22432# Oak Ridge National Lab., Tenn.
RADIATION PHYSICS
G. S. Hurst *In its* Health Phys. Div. Oct. 1966 p 121–169 refs (See N67-22429 11-04) CFSTI: HC $3.00/MF $0.65

Various brief summaries of research are presented on the following areas: theoretical radiation physics, atomic and molecular radiation physics, interaction of radiation with solids and liquids, and physics of tissue damage. NSA

N67-22433# Oak Ridge National Lab., Tenn.
RADIATION DOSIMETRY
J. A. Auxier *In its* Health Phys. Div. Oct. 1966 p 171–210 refs (See N67-22429 11-04) CFSTI: HC $3.00/MF $0.65

Progress is reported in the evaluation of γ and neutron doses received by residents of Hiroshima and Nagasaki exposed to the effects of atomic explosions and the effects of various

shielding parameters on the radiation doses. A transistorized fast neutron dose integrator was built for use in the presence of severe environmental conditions. Neutron cross sections are presented for the production of γ rays in air by the $^{14}N(n,\gamma)^{15}N$; $^{14}N(n,\alpha)^{11}B$; $^{40}Ar(n,\gamma)^{41}Ar$; $^{16}O(n,n')^{16}O$; $^{16}O(n,\alpha)^{13}C$; or $^{16}O(n,p)^{16}N$ reactions that show that ^{14}N is the dominant γ producing source in air with most of the γ rays coming from the inelastic scattering of neutrons by ^{14}N and ^{16}O. Neutron-energy threshold detector units employing solid-state nuclear tract detectors were improved by replacing the conventional fissile foils with fissile radiators and nuclear track detectors. Results are reported from an intercomparison of nuclear accident dosimetry systems in which 7 groups participated. The sensitivity of cellulose acetate butyrate for use in solid-state α particle track detection was evaluated. Plastics were irradiated with helium ions and deuterons using the DOSAR low-energy accelerator and the design is described of a deflection chamber for use with a pair of beam deflection plates on the target end of DOSAR during the irradiation. The final endurance testing of the 150-keV positive-ion accelerator (HPRR) was completed. NSA

N67-22434# Oak Ridge National Lab., Tenn.
INTERNAL DOSIMETRY
W. S. Snyder *In its* Health Phys. Div. Oct. 1966 p 211-241 refs (See N67-22429 11-04) CFSTI: HC $3.00/MF $0.65

The revision of the standard man is suggested to include the information needed for the estimation of radiation dose, whether from external or from internal sources, to provide an estimate of the variability of dose due to individual differences, and to afford methods of adjusting the estimate to correct for an individual's characteristics. Data are presented on the mass (in g or ml) and the percent of total body of 52 tissues and organs based on a 70 kg man. The use of the model in studies on the deposition and clearance of particulate matter from the respiratory tract is discussed and methods and formula for obtaining dose estimates of radioactive aerosols are presented. Phantoms of infants and adults were used to determine variations in the radiation dose ($\beta+\gamma$) from a given unit source of ^{137}Cs in the body of man as a function of body size and position of the source in the body. A three-compartment model for iodine metalbolism by the thyroid and by the body is presented that is valid radioactive iodine. Computer studies are discussed on the linear combination of exponentials representing power functions used to represent data on excretion from and retention in the body of bone-seeking radionuclides. NSA

N67-22435# Oak Ridge National Lab., Tenn.
HEALTH PHYSICS TECHNOLOGY
B. R. Fish *In its* Health Phys. Div. Oct. 1966 p 243-267 refs (See N67-22429 11-04) CFSTI: HC $3.00/MF $0.65

Mechanisms for the adhesion of solid particles to surfaces are reviewed with emphasis on capillary and electrostatic forces that may affect the accidental resuspension of radioactive particles from surfaces in the working environment. Data are included from a study of electrical forces in the adhesion of particles. Preliminary results of spectrum and radiation dose measurements from discrete β-emitting sources in contact with or implanted in the skin are reported and methods are described. Methods for the dosimetry of small intense β-emitting particles deposited on the skin or in the gastrointestinal tract of man are discussed and techniques using extrapolation dosimetry using an anthracene scintillation detector and computer analysis of data and ionization extrapolation chamber are compared. Methods for correcting ^{239}Pu wound counts for attenuation in tissues and for the ratio of ^{241}Am to ^{239}Pu were investigated. Methods are described that were used to measure the absorption of ^{90}Sr from a puncture wound of the finger made by a stainless steel wire contaminated with $^{90}Sr+^{90}Y$. The absorption of ^{90}Sr into the body was studied by analysis of blood and urine and residual ^{90}Y in the finger was determined by counting β activity with an end-window GM beta counter. Methods of sample preparation for the determination of ^{85}Sr and ^{90}Sr in urine are discussed. NSA

N67-22555# Tulane Univ., New Orleans, La. Delta Regional Primate Research Center.
ANALYSIS OF POSITIONAL BEHAVIORS IN THE RHESUS MONKEY (MACACA MULATTA) Technical Report, May 1, 1965-Aug. 31, 1966
Joan Deutsch Oct. 1966 45 p refs
(Contract Nonr-475(II); Grant PHS-FR-00164-03)
(TR-66-1; AD-645538) CFSTI: HC $3.00/MF $0.65

Systems and methodologies for the classification and description of motor behavior were evaluated in the light of the present needs of psychologists, primatologists, and investigators of electrically elicited movement in primates. The system developed in this study involved an angular-displacement kinematic analysis of the relations established between units of the body anatomy of monkeys during spontaneously occurring activity. Approximate angular displacements of body units were measured by means of a protractor from sketches of animals in profile traced from sequences of stills of movie film. Sitting, bipedal and quadrupedal standing postures were classified according to the most widely varying positional elements such as the amount and level of back curvature or leg flexion. The mode and the range of specific classes of the postures were specified and examples of the modal patterns were presented. Quadrupedal walking sequences which represented the most frequently observed sequence of foot contact with the substrate were analyzed, and the angular displacements of the body units and their temporal relations during successive phases of the locomotion were measured. Two extreme types of quadrupedal walking were differentiated in terms of positional elements, timing and patterning. The specific social and physical referants for the derived classes of postures and quadrupedal locomotion were specified. The possible applications of this system of analysis of positional behavior to special and general areas of neurophysiological and psychological investigation were discussed. Author (TAB)

N67-22581*# Neurosciences Research Program, Brookline, Mass.
NEUROSCIENCES RESEARCH PROGRAM BULLETIN, VOLUME 4 (SUPPLEMENT)
15 Jul. 1966 97 p refs
(Grants NsG-462; NIH-GM-10211-04; Nonr(G)-00067-65)
(NASA-CR-83422) CFSTI: HC $3.00/MF $0.65 CSCL 06P

CONTENTS:

1. CORRELATIONS BETWEEN SPECIFIC HUMAN BRAIN LESIONS AND MEMORY CHANGES R. G. Ojemann p 1-70 refs (See N67-22582 11-04)

2. HYSTERESIS AND MACROMOLECULAR MEMORY A. Katchalsky and A. Oplatka p 71-93 refs (See N67-22583 11-04)

N67-22582*# Massachusetts General Hospital, Boston.
CORRELATIONS BETWEEN SPECIFIC HUMAN BRAIN LESIONS AND MEMORY CHANGES
Robert G. Ojemann *In* Neurosci. Res. Program Bull., Vol. 4 (Suppl.) 15 July 1966 p 1-70 refs (See N67-22581 11-04) CFSTI: HC $3.00/MF $0.65

A critical survey is presented of the literature that correlates a specific loss of brain tissue with the details of the memory deficit or lack of it. Cases related to surgical removal, disease, or congenital absence are considered. Changes in memory are described in three general categories: a loss of ability to store recent memory, as measured by the inability to learn or record ongoing day-to-day events; amnesia for events immediately prior to the loss of brain tissue, with the period varying from less than a

day to several months; and memory for events occurring several years before the lesion. Clinical case histories are presented on lesions associated with medial temporal lobe, lateral temporal lobe, entire temporal lobe, fornix, hippocampus, commissures, thalamus, hypothalamus, third ventricle and adjacent structures, frontal lobe, corpus callosum and cerebral commissures, and multiple brain regions. The various tests of memory functions which were used are described. An annotated bibliography is included. M.G.J.

N67-22583*# Weizmann Inst. of Science, Rehovoth (Israel). Polymer Dept.
HYSTERESIS AND MACROMOLECULAR MEMORY
Aharon Katchalsky and Abraham Oplatka *In* Neurosci. Res. Program Bull., Vol. 4 (Suppl.) 15 July 1966 p 71–93 refs (See N67-22581 11-04) CFSTI: HC $3.00/MF $0.65

The requirements imposed on memory devices as an integral part of cybernetic self-organizing systems are examined. Memory devices, in this context, are defined as the means for recording, storage, and readout of individual experience, as distinguished from the hereditary memory underlying the master plan of an organism. Working hypotheses for interpretating subcellular memory storage and readout are reviewed; the mechanisms suggested assume that memory imprints involve changes in the primary structures of suitable macromolecules. Data are presented to indicate that there exists the possibility of a physical record in biopolymers based on conformational changes in single macromolecules or in cellular macromolecular structures such as membranes. Since hysteresis is a suitable indicator for the existence of mestastable forms of high permanence, hysteresis phenomena are discussed, and consideration is given to metastable macromolecular conformations with a capacity for memorizing the imprint of surrounding events. Experimental results are presented on the hysteresis behavior of RNA, and on a thermodynamic analysis of the cycles exhibited by the simpler structures. M.G.J.

N67-22864*# Massachusetts Inst. of Tech., Cambridge.
COMMUNICATIONS BIOPHYSICS
P. R. Gray, P. G. Katona, W. T. Peake, W. M. Siebert W. A. Rosenblith et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 311–332 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Grants NsG-496; NIH 5-R01-NB-05462-03; NSF GK-835; NIH 2-PO1-MH-04737-06; Contract DA-36-039-AMC-03200(E))

Electrophysiological and behavioral experiments emphasizing hearing are reported. Research on the peripheral auditory system, neuroelectrical correlates of conditioning, psychophysics, neurophysiology, EEG studies, and cardiovascular system are summarized. An electrical analog for the mechanical system of the middle ear of cats is described. A system is presented of time-division multiplexing employing a magnetic delay drum to provide filtering of two signals in which the disturbance is of the same frequency in both. Studies on the arterial pressure receptors indicate that the firing pattern of single pressure receptor nerves is reproducible when the pressure waveform is periodic, and that nerve firings tend to occur at well-determined instances of time. N.E.N.

N67-22865*# Massachusetts Inst. of Tech., Cambridge.
NEUROPHYSIOLOGY
W. S. McCulloch, J. Y. Lettvin, P. D. Wall, M. Blum, J. E. Brown et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 333–346 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65

A calculus for triades is presented. Definitions are included and unary, binary, and triadic operations are described. Theorems are given which follow the combining of closed operations among triades. N.E.N.

N67-22724# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF REDUCED BAROMETRIC PRESSURE ON THE SECRETORY FUNCTION OF SALIVARY GLANDS
S. I. Filippovich 3 Aug. 1966 26 p refs Transl. into ENGLISH from Arkhiv Biologicheskikh Nauk, v. 58, no. 3 p 3–17
(FTD-TT-65-1678; AD-645857) CFSTI: HC $3.00/MF $0.65

Experiments conducted on people and animals at reduced barometric pressure in a pressure chamber at different altitudes (from 4000 to 10000 m) gave the following results: The first ascents after 4-5 hours in the pressure chamber produced an appreciable decrease in the secretion of salivary glands in response to a food stimulant and to acid, this decrease being frequently replaced by an increase in secretion in the following days. The aftereffect in dogs continued for up to five to seven days, and in man, three to four days. The first ascents produced an increase (frequently abrupt) of spontaneous salivation. A decrease in the organic components of the saliva of dogs at altitude was observed, and also an increase in the amount of urea in the saliva; in people (4000 m altitude) an increase in the dense residue and in many cases an increase in the diastatic strength of the saliva and an increase in urea were observed. In oxygen inhalation, the above-described changes in people (altitudes up to 8 km) were expressed to a considerably lesser degree, and were completely absent in dogs in most cases (altitudes up to 10 km). In repeated ascents, the period of the aftereffect gradually became shorter. In dogs after four to five ascents without oxygen, the changes were observed only in the pressure chamber itself, and the aftereffect disappeared. Adaptation phenomena occurred faster and were more stable in short-term and systematic ascents. Author (TAB)

N67-22740# Geoscience, Ltd., Solana Beach, Calif.
WHOLE ORGAN FREEZING AND THAWING HEAT TRANSFER AND THERMAL PROPERTIES Quarterly Report, Oct. 1–Dec. 31, 1966
Heinz F. Poppendiek, Norman D. Greene, and R. Randall 31 Dec. 1966 19 p refs
(Contract Nonr-4095(00))
(GLR-50; AD-646333) CFSTI: HC $3.00/MF $0.65

Thermal conductivity measurements for water and ice down to cryogenic temperature ranges were made and are compared to other information found in the literature. Conductivity measurements for bovine liver in the unfrozen and frozen states were also determined and compared to the behavior of water and ice. Heat capacity measurements of bovine liver in the unfrozen and frozen states were determined and compared to the values known for water. The numerical and analytical techniques used to investigate the transient temperature behavior of idealized biological materials that are being cryogenically frozen and thawed are presented. The techniques were applied to a representative slab problem and the results presented. Author (TAB)

N67-22885*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY, FEBRUARY, 1967
Mar. 1967 48 p refs
(NASA-SP-7011(35)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The bibliography with abstracts is composed of entries formerly announced in *Scientific and Technical Aerospace Reports*, and *International Aerospace Abstracts*, and those made available by the Library of Congress. The subject coverage concentrates on the biological, physiological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. A subject index, corporate source index, and personal author index are included. N.E.N.

N67-22898*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY — A CONTINUING BIBLIOGRAPHY, 1966

Jan. 1967 929 p refs

(NASA-SP-7011(33)) CFSTI: HC$3.00/MF$0.65 CSCL 06S

A cumulative index is presented for the past 12 issues of a continuing bibliography on aerospace medicine and biology. The publication includes entries from NASA's *Scientific and Technical Aerospace Reports* and *International Aerospace Abstracts* and is indexed by subject, corporate source, and personal author. S.P.

N67-23029# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz.

ISODOSES OF THE Cs RADIATION EQUIPMENT OF THE KFA JUELICH (PROBLEM OF THE DEEP RAY THERAPY) [ISODOSEN DER Cs-BESTRAHLUNGSANLAGE DER KFA JUELICH (PROBLEME DER TIEFENSTRAHLENTHERAPIE)]

K. Kasperek and H. G. Schnippering Sep. 1964 38 p refs In GERMAN

(JUL-194-ST) CFSTI: HC$3.00/MF$0.65

The application of isotopic cesium radiation for therapeutical and diagnostic purposes in a radiological institute is discussed. Nine tubular attachment geometries in front of the cesium isotope container are evaluated for their focusing at deep penetration dosage in a water tank and the measurements are combined graphically. Results indicated that the use of several tubes with one focused, bundled beam diminishes scattering, insures proper penetration depth of the carcinoma, and gives better protection for the surrounding healthy tissues. Transl. by G.G.

N67-23049# Army Medical Research Lab., Fort Knox, Ky. Pathology Div.

HEMATOLOGICAL DATA ON THE SOOTY MANGABEY MONKEY *(CERCOCEBUS TORQUATES ATYS)*

Martin A. Ross and Winslow G. Sheldon 12 Sep. 1966 26 p refs

(Rept.-679; AD-645448) CFSTI: HC$3.00/MF$0.65

The average hematologic values of the species reported show some variations from the values for other species reported in the literature. In particular, the total RBC counts appear to be somewhat lower while hemoglobin and packed cell volumes are somewhat higher than in other species. The differential counts show a marked prevalence of lymphocytes as opposed to neutrophils being present in a ratio of about 3 to 1, whereas in other species the ratios range from 1 to 1 to 2 to 1. The sooty mangabey, an Old World species of subhuman primate, seem to be suitable animals for many research programs as they are reasonably available, relatively inexpensive, and are no more difficult to maintain than other varieties. Author (TAB)

N67-23050# Pisa Univ. (Italy). Inst. of Physiology.

COMPARATIVE NEUROPHYSIOLOGY OF VISION Final Scientific Report, Sep. 15, 1965–Sep. 14, 1966

Giuseppe Moruzzi 15 Sep. 1966 13 p refs

(Grant AF-EOAR-61-(052)-830)

(AFOSR-66-2764; AD-643497) CFSTI: HC$3.00/MF$0.65

The results of the following investigations are reported: (1) Visual control of flashing in fireflies; (2) Evidence of presynaptic inhibition in the lateral geniculate body following reticular stimulation; (3) Presynaptic inhibition in the lateral geniculate body with regard to the problem of reciprocal binocular interaction; (4) Receptor and neural responses in the cats retina; (5) Temporal and spatial relations in retinal units; (6) Surgical immobilization of eye and pupil. TAB

N67-23087# Istituto Superiore Di Sanita, Rome (Italy). Laboratori Di Fisica.

ON THE ACID AND ALKALINE DENATURATION OF DNA AND ITS DEPENDENCE ON THE SALT CONCENTRATION

E. Dore and C. Frontali 28 Sep. 1966 18 p refs Sponsored by the Consiglio Nazl. Delle Ric.

(ISS-66/33) CFSTI: HC$3.00/MF$0.65

The results of a systematic study carried out to clarify the effect of variations in pH and salt concentration on the state of DNA in solution, are described. The results are presented in the form of a map, which shows the ranges of pH and salt concentration in which DNA is found either in the native or in the denatured state. In contrast with what has been claimed by several authors, the DNA we used remains in the native state in distilled water, at neutral pH, for periods exceeding 24 hours. The reasons for this discrepancy may be sought in the high molecular weight of this DNA. Measurements of the intrinsic transition width for alkaline denaturation yielded a value of 0.35 pH units, which can be considered as the upper limit. Author

N67-23105# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.

RECOVERY FROM IMPULSE NOISE INDUCED ACOUSTIC TRAUMA

J. L. Fletcher and A. B. Cairns 22 Nov. 1966 10 p

(Rept.-686; AD-645898) CFSTI: HC$3.00/MF$0.65

Recovery from impulse noise induced acoustic trauma was examined in soldiers stationed at Fort Knox, Ky. Serial audiograms were obtained on the day of exposure, one day, three days, one week, two weeks, four weeks, six weeks, 12 weeks, four months, five months, and six months post exposure. Recovery from temporary threshold shifts as large as 35 dB was observed at frequencies from 500 - 2,000 cycles. At the higher frequencies shifts of magnitudes as great as 85 dB were observed with good recovery most of the time. Our results indicate that for legal purposes six months is a minimum waiting period necessary to substantiate permanent hearing loss. However, recovery at the speech frequencies is essentially complete in about two weeks. Author (TAB)

N67-23119# Northwestern Univ., Evanston, Ill.

AUDITORY FUNCTION OF THE HEARING IMPAIRED Formal Progress Report, No. 41 16 Jun.–15 Dec. 1966

T. W. Tillman 15 Dec. 1966 31 p

(Contract AF 41(609)-2643)

(AD-645616) CFSTI: HC$3.00/MF$0.65

The specific goals of the project are: (1) the development of test procedures for assessing the effects of hearing impairment on receptive communicative efficiency in difficult listening environments; (2) the development of valid methods for detecting the individual whose hearing has deteriorated to the point where he has become a hazard to himself and others because of reduced communicative capacity. Author (TAB)

N67-23122# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

MUSCLE SHORTENING HEAT: ENERGY DISSIPATION DUE TO STRUCTURAL DAMPING Research Paper

Alexander F. Metherell Jul. 1966 38 p refs *Its* Res. Commun. No. 11

(Douglas Paper-4139; AD-644988) CFSTI: HC $3.00/MF $0.65

The paper presents a study to predict theoretically the main source and effect of structural damping in the contractile component of muscle. The most obvious source is the coulomb friction effects at the contact sites between the myosin cross-bridges and the actin filaments. The equation derived for the energy dissipated during filament sliding due to the friction at these sites is Energy dissipation = (pPo + qPfix. Since this expression agrees with A. V. Hills (1964a) equation for heat of shortening, it is concluded

that heat of shortening is a structural damping phenomenon. The interface tension theory presented in the preceding paper (Metherell, 1966) is modified to take account of these structural damping effects. The energy relation, when taking account of the strain energy h stored in the series elastic component, is shown to be E = A + alpha x + We + h which is the same as the equation that Hill (1964c) obtained experimentally. Author (TAB)

N67-23123# Stanford Research Inst., Menlo Park, Calif.
SURVEY OF MICROCELLULAR RESEARCH
Robert C. Minnick Jul. 1966 70 p refs
(Contract AF 19(628)-5828)
(SR-1; AFCRL-66-475; AD-637010) CFSTI: HC $3.00/MF $0.65

This report is a survey of research on microcellular techniques. Of particular interest are those techniques that are appropriate for realization by modern batch-fabrication processes, since the rapid emergence of reliable and economical batch-fabricated components represents probably the most important current trend in the field of digital circuits. First the manufacturing methods for batch-fabricated components are reviewed, and the advantages to be realized from the application of the principles of cellular logic design are discussed. Also two categorizations of cellular arrays are made in terms of the complexity of each cell (only low-complexity cells are considered in this report), and in terms of the various application areas. After a survey of very early techniques that can be viewed as exemplifying cellular approaches, modern-day cellular arrays are discussed on the basis of whether they are fixed cell-function arrays or variable cell-function arrays. In the fixed cell-function arrays the switching function produced by each cell is fixed; the cell parameters are used only in the modification of the interconnection structure. Several versions of NOR gate arrays, majority gate arrays, adder arrays, and others are reviewed in terms of synthesis techniques and array growth rates. Similarly, the current status of research is summarized in variable cell-function arrays, where not only the interconnection structure, but also the function produced by each cell is determined by parameter selection. Author (TAB)

N67-23171# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DIURNAL RHYTHM OF FUNCTIONS OF HUMANS IN CONDITIONS OF LIMITED MOBILITY
N. Ye. Panferova 17 Nov. 1966 17 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, 1963 p 741–749
(FTD-TT-65-1994; AD-646291) CFSTI: HC $3.00/MF $0.65

The diurnal rhythm of man's physiological functions is a complex reaction that developed in the process of phylogenic and ontogenic adaptation of living organisms to the conditions of vital activity on earth. According to certain of the literature it is inborn. It appears sharply in the second year of life and becomes more expressed as the individuals age increases. In adults it is relatively stable. Certain experiments were performed in which certain individuals were suspended in water and other were kept in chairs and indulged in various activities without strong physical exertion. When man is subjected to prolonged immobility the ordinary diurnal rhythm of the body temperature changes. The diurnal variations become less expressed; in a number of cases at night, a rise in body temperature was observed instead of a drop, and in the daytime it was reduced. The body temperature stays at one level for a long time, but its changes have a step-wise character. The curves of the body temperature diurnal variations for the same subject had different configurations during different days of the experiment. Under conditions of limited mobility the diurnal variations of the pulse rate and the maximal blood pressure became less expressed. The change in the diurnal variations of the pulse and respiration rates and blood pressure under conditions of limited mobility is less expressed than the change in the diurnal variations of the body temperature. The diurnal changes in the pulse and respiration rates also do not always repeat the diurnal body temperature changes. Author (TAB)

N67-23236# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY Semiannual Report, Jan.–Jun. 1966
Aug. 1966 17 p refs
(Contract AT(07-2)-1)
(DPST-66-30-2) CFSTI: HC $3.00/MF $0.65

The results of the environmental monitoring program for the period January 1 through June 30, 1966, for the atmosphere, vegetation and food, and water are reported. The quantity of radioactive waste released by the Savannah River Plant to its environs was, for the most part, too small to be distinguished from natural background radiation or was obscured by worldwide fallout from nuclear weapons testing. Fallout from the Chinese nuclear test on May 9, 1966, was detected at SRP. Beta activity in air, which showed no relation with plant operations, was about one-half of that for the same period of 1965. Radioactive materials in fish flesh continued to be far below levels considered significant from a health standpoint. The average concentration of radionuclides in river water did not exceed 3.7% of the Maximum Permissible Concentrations. Author (NSA)

N67-23251*# Naval School of Aviation Medicine, Pensacola, Fla. Aerospace Medical Inst.
THE EGOCENTRIC LOCALIZATION OF THE VISUAL HORIZONTAL IN NORMAL AND LABYRINTHINE-DEFECTIVE OBSERVERS AS A FUNCTION OF HEAD AND BODY TILT
Brant Clark and Ashton Graybiel 17 Jan. 1967 11 p refs Joint Rept. with NASA
(NASA Order R-93; Proj. MR005.04-0021)
(NASA-CR-83525; NAMI-991; Rept.-142) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Perception of the visual horizontal by observers in five different combinations of head and body position was studied to determine the effect of 20-degree body tilts. Both normal and labyrinthine-defective observers made five settings to the visual horizontal for each condition using a goggle device which presented a collimated line of light to the right eye while the other eye was covered. The results showed no significant constant errors in the settings by either group, and it is suggested that the absence of the E-phenomenon was due primarily to adequate contact cues and kinesthetic cues. The data also make it clear that vestibular information is not required for veridical perception of the visual horizontal under these experimental conditions. Author

N67-23252*# Indiana Univ., Bloomington. Dept. of Anatomy and Physiology.
THE INFLUENCE OF ALTITUDE ON THE ANAEROBIC AND AEROBIC CAPACITIES OF MEN IN WORK Final Scientific Report
C. Dawson, E. D. Michael (Calif. Univ., Santa Barbara), L. G. Myhre, S. Robinson, J. L. Newton et al 31 Dec. 1966 15 p refs
(Grant NsG-408)
(NASA-CR-83526) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Maximal aerobic and anaerobic capacities were measured on four men working to exhaustion on a bicycle ergometer before, and on an ergometer and a treadmill during a 5-week sojourn on White Mountain (altitude of 3800 m). In the first 10 days at 3800 m maximal values for work capacity, O_2 uptake, ventilation (STPD) and heart rate were markedly lower, but little change was observed in oxygen debt and blood lactate following work. During the remaining 5 weeks at 3800 m the tolerance time for a fixed rate of exhausting work increased 16% without a corresponding increase in maximal O_2 consumption. Accompanying this increase in work capacity were increases in lactate (30%) and O_2 debt (5%) during the stay at altitude. The increase in maximal work performance during the stay at 3800 m is attributed to an increasing

ability to utilize energy from the anaerobic mechanisms and an improvement in the efficiency of work on the ergometer in the men who were not accustomed to work on the bicycle. Upon return maximal values for O_2 debt, O_2 uptake, ventilation (STPD), duration of work and lactate were not only greater than the altitude values, but also considerably higher than the prealtitude controls. Author

N67-23255*# Indiana Univ., Bloomington. Dept. of Anatomy and Physiology.
DISTRIBUTION OF LACTIC ACID BETWEEN PLASMA AND RED CELLS DURING WORK AND RECOVERY
J. L. Newton and S. Robinson 31 Dec. 1966 9 p refs
(Grant NsG-408)
(NASA-CR-83529) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Lactic acid concentrations in whole blood, plasma and red cells were determined on samples drawn from the femoral veins of men during 2 to 3-minute runs to exhaustion on the treadmill. Plasma lactate concentration increased rapidly during the runs, but the rise in whole blood was slowed by the delayed diffusion of lactate into the red cells during the first 1 to 2 minutes of work. In one man plasma lactate in femoral vein blood began to decline within 30 seconds after a 3 minute exhausting run, while lactate continued to diffuse into the red cells for 10 minutes following the run. In another man plasma and cell lactates continued to rise for 2 to 20 minutes respectively following a 2-minute run to exhaustion. This delayed diffusion of lactate into the red cells contributes to the continued increase in whole blood lactate following strenuous work. Author

N67-23267*# Arkansas Univ., Little Rock.
THE ROLE OF NUCLEOTIDE METABOLISM IN THE REPAIR OF RADIATION INJURY Semiannual Progress Report, 1 Oct. 1966–1 Apr. 1967
1 Apr. 1967 8 p refs
(Grant NGR-04-001-014)
(NASA-CR-83540) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Continuing research in the role of nucleotide metabolism in the repair of radiation injury is summarized, including reports on the effect of Co^{60} gamma radiation on respiration and ATP metabolism of L cells, the effect of Co^{60} gamma radiation on nucleotide metabolism of L cells, a nonlinear method for fitting cell survival curves, the effect of Co^{60} gamma radiation on ATP synthesis by L cells, and the effect of 2,4 dinitrophenol on ATP synthesis and post-irradiation survival by L cells. L.E.W.

N67-23270*# Naval School of Aviation Medicine, Pensacola, Fla.
RADIATION MONITORING WITH NUCLEAR EMULSIONS ON PROJECT GEMINI. II. RESULTS ON THE 14-DAY MISSION GEMINI VII
Hermann J. Schaefer and Jermiah J. Sullivan 11 Jan. 1967 16 p refs Prepared jointly with NASA
(NASA-CR-83543; NAMI-990) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Small nuclear emulsion packs worn by the astronauts at three locations inside their space suits were evaluated by track, grain, and enders count for evaluation of LET spectrum and absorbed dose. By using G.5/K.2 emulsion pairs, a sustained resolution over the entire LET scale of protons from zero to relativistic energies was obtained. It was found that the energy dissipation centers heavily on low energies, with 40 percent of the absorbed dose due to protons of less than 0.1 g/cm^2 residual range. Total proton doses at the six locations (left and right chest, thigh pocket of each astronaut) varied from 159 to 233 millirads. The enders count was found to vary by as much as a factor of 1.35 within the same 1 by 1-1/2-inch film sheet, indicating that the radiation field within the vehicle not only varies over distances comparable to body size, but also reflects local inhomogeneties of shielding conditions on a centimeter and millimeter scale. Author

N67-23331*# Naval School of Aviation Medicine, Pensacola, Fla.
KINEMATICS NOMENCLATURE FOR PHYSIOLOGICAL ACCELERATIONS WITH SPECIAL REFERENCE TO VESTIBULAR APPLICATIONS
W. Carroll Hixson, Jorma I. Niven, and Manning J. Correia 8 Aug. 1966 98 p refs *Its* Monograph 14
(NASA Order R-93)
(NASA-CR-83568) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A mathematical nomenclature in the language of kinematics has been formulated to provide precise, man-referenced identifications of the real accelerations comprising the basic vestibular stimuli and of certain selected vestibular response measures. The system is based on establishing anatomical landmarks in the form of three mutually orthogonal cardinal head axes and planes to which the magnitude and direction characteristics of both the acceleration stimuli and the vestibular responses can be referenced. Notation is provided to describe separately the resultant linear acceleration and the resultant angular acceleration arising in any force environment in terms of their components acting along and about, respectively, the three cardinal axes. The notation and application format of the nomenclature has application in the general acceleration physiology field as well as the vestibular area. Author

N67-23353# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A MODEL FOR THE RENAL BLOOD FLOW REGULATING MECHANISM
Robert P. Couch (M.S. Thesis) Nov. 1966 85 p refs
(GNE/PH/67-4; AD-645891) CFSTI: HC $3.00/MF $0.65

A flexible tube model of the renal blood flow regulating mechanism was studied from both a theoretical and an experimental standpoint. The one dimensional steady flow equations of a flexible tube subject to an external collapsing pressure were solved using an iterative third order Runge-Kutta technique. The equations were solved for the cases where (1) the collapsing pressure is independent (open loop), and (2) the collapsing pressure is derived at some point upstream (closed loop). Experimental measurements were made on a model (constructed of Penrose tubing) under steady and oscillating flow conditions. The model exhibited flow regulation characteristics similar to those of an actual kidney. The theory predicted the regulation and stability characteristics of the system within about 15%. It was found that the regulation could be improved so that a doubling of pressure caused only an 0.5% change in the flow rate. Author (TAB)

N67-23371# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIGNAL PROCESSING CHARACTERISTICS OF THE PERIPHERAL AUDITORY SYSTEM
Thomas J. Goblick, Jr. and Russell R. Pfeiffer 30 Sep. 1966 142 p
(Contract AF 19(628)-5167)
(ESD-TR-66-449; TN-1966-50; AD-645781) CFSTI: HC $3.00/MF $0.65

The fundamental question in speech compression is that of determining the minimum information rate that must be maintained between speaker and listener in order to achieve a specified level of speech fidelity or quality. The problem in answering this question is that a measure of speech quality must first be defined. Any meaningful definition of speech quality clearly must consider the manner in which speech is processed by the listener. If the details of the signal processing in the auditory system were known, speech quality could be defined in terms of the sensitivity of the listener to distortions of signals within the auditory system. A study of the manner in which sounds are processed by the human auditory system was done to provide the basic information to define a measure of speech fidelity. The mechanical or soundconducting parts of the auditory system are reasonably well understood and can be considered as linear systems in an engineering sense. The neural processing of the peripheral auditory

system is only partly understood. Further experimental work is necessary. Author (TAB)

N67-23402# Joint Publications Research Service, Washington, D. C.
BIOLOGICAL PROBLEMS IN SPACE FLIGHT
M. Kh. Bengson and F. U. Toma 7 Feb. 1967 6 p Transl. into ENGLISH from Priroda (Moscow), no. 11, 1966 p 29–31
(JPRS-39804; TT-67-30452)

The effects of an isolated biologically limited medium on the changes and simplifications of the intestinal flora in humans are discussed. It is noted that in the sterile conditions of space flight that a reduced number of species of microorganisms are observed in the intestinal microflora. Lethal simplifications of microflora are discussed along with the changes that occur quicker than the consequences can be avoided. Possibilities of combating these effects are suggested; and include control over existing conditions, the introduction of antibiotics in diets, and sterilization of spacecraft before flight. C.T.C.

N67-23403# Joint Publications Research Service, Washington, D. C.
RELATIVE BIOLOGICAL EFFECTIVENESS OF VARIOUS TYPES OF RADIATIONS
M. P. Domshlak 3 Feb. 1967 44 p refs Transl. into ENGLISH from the book "Voprosy Obshchey Radiobiologiya" Moscow, Atomizdat., 1966
(JPRS-39774; TT-67-30422)

Consideration is given to the relative biological effectiveness (RBE) of various types of radiations to induce a response of a definite strength at a given absorbed dose, usually in comparison with X-rays. The numerical value of the RBE is defined as the ratio of the doses of the given radiation and X-ray radiation necessary to obtain the same effect. Relative to this, investigations are made of the physical aspects of the RBE, the RBE of high-energy protons, and model studies of the biological effects of cosmic radiation. C.T.C.

N67-23409# Joint Publications Research Service, Washington, D. C.
CHANGES IN THE ERYTHROCYTES OF RATS TRAINED TO HYPOXIA
A. I. Barbeshova and G. I. Grigor'yeva 18 Jan. 1967 13 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 52, no. 11, Nov. 1966 p 1346–1352
(JPRS-39586; TT-67-30235)

An investigation was made of the hypothesis that the osmotic erythrocyte resistance (OER) increase in rats adapted to hypoxia might be connected with an altered cation permeability of the erythrocyte membranes. The experimental method is described, and the results are discussed with the aid of graphs and tables. It was found that the adenosine triphosphatase activity (ATP) of the blood plasma was reliably increased in rats trained to hypoxia during winter and spring seasons. Since this increase showed no correlation with the general resistance to hypoxia or with the change in osmotic resistance of erythrocytes, it is regarded as not in connection with OER changes. The ATP activity of erythrocytes decreased in the experiments of winter series, where the rats proved to be well adapted and the osmotic resistance of blood cells was increased. The buffer capacity of the hemolysate of erythrocytes cleared of plasma was increased in well adapted rats (winter series). C.T.C.

N67-23422# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH ON THE NEURAL EFFECTS OF MICROWAVES
Christopher Dodge and Simon Kassel 7 Nov. 1966 38 p refs
(ATD-66-133)

The primary purpose of the report is to outline Soviet research on the effect of low-intensity microwave radiation on the central nervous system of living organisms, including man. The organizations and individual researchers, subject development, specific neural functions and structures, in vivo neural effects, neural effects of low-frequency electromagnetic and magnetic fields, clinical, therapeutic, and hygienic aspects are considered. The discussion which follows summarizes important facts and deductions from the foregoing sections and speculates on the intensity and type of Soviet research efforts in this area in the future. The bibliography at the end of the report includes 42 entries. Author

N67-23440# Israel Program for Scientific Translations, Ltd., Jerusalem.
STAUB, VOLUME 26, NO. 8
Aug. 1966 47 p refs Transl. into ENGLISH from German Published for NSF and Dept. of Health, Educ. and Welfare
CFSTI: HC $3.00/MF $0.65

Hygiene effects and control of dusts, fogs, gases, vapors, and radioactive particles are discussed. The terms dust and very fine mineral particles are defined, and microscopes used in determining mineral particles are described. The limiting dark field method of particle size determination in a range from 6μ to 0.2 mm and the hot stage microscope for direct observation of melting up to 1600°C in transmitted light are described as the new methods using optical microscopy. The importance of dust containing germs in working places is explained. The applicability of aerosols in xerography is discussed, and with simplified assumptions the velocity at which aerosols settle on charged surfaces is calculated. Determinations of size and electric charges of individual particles of different aerosols were made, and the particle size distribution of nearly all aerosols followed Gaussian distribution. A nomogram is given in the form of a slide rule for the rapid conversion of particle-number concentrations to gravimetric concentrations of industrial aerosols. Studies are presented on the concentration of absorption solutions of primary aliphatic amines and the generation of amine/air mixtures used to check these methods. Additional topics considered are air filters, dust collectors, vacuum cleaners and sweepers, and trace substances in non-polluted air. S.P.

N67-23486 Army Electronics Labs., Ft. Monmouth, N. J.
THE MENTAL PROCESS
Marco T. Bonfitto [1967] 16 p refs

The empirical approach is used to deduce the logic scheme of the human brain in identifying the various contingencies encountered by man within his local environment by the use of sensual receptors (the matter of perception). How the output of the logic network is matched to the memory network to produce reflex action is shown in block diagram of a differential circuit of the overall complex. An electronic model of the human nervous system is conceived, and the intrinsic functional elements are indicated. Finally, education and the means of instilling memory or knowledge is shown. Limitations and psychological features are also intimated within the context of the paper. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-21961*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
JET SHOES—AN EXTRAVEHICULAR SPACE LOCOMOTION DEVICE
David F. Thomas, Jr., John D. Bird, and Richard F. Hellbaum Washington, NASA, Apr. 1967 33 p refs Technical Film Supplement L-892 available on request
(NASA-TN-D-3809) CFSTI: HC$3.00/MF$0.65 CSCL 06B

This report presents the results of an investigation into the feasibility of an extra-vehicular locomotion device. This device consists of low thrust jets mounted on the soles of a pair of shoes to provide a controllable thrust vector which can be used to produce translational and rotational motions. It was found that with a little practice, the subject could control his attitude and motion with a reasonable degree of precision. Author

N67-22522# State Univ. of Iowa, Iowa City.
FACILITATION AND INTERFERENCE IN PERFORMANCE ON THE MODIFIED MASHBURN APPARATUS. II: THE EFFECTS OF VARYING THE AMOUNT OF INTERPOLATED LEARNING
Don Lewis and Dorothy E. McAllister [1966] 16 p refs
(Contract N9onr-93801)
(SDC-938-1-2; AD-643407) CFSTI: HC$3.00/MF$0.65

A previous report showed that the amount of interference in performing on the Modified Mashburn Apparatus increased with increasing amounts of original learning (OL). During OL, groups of male subjects were given different amounts of practice on the standard Mashburn task. Then after practicing for some fixed number of trials on the reversed task, they relearned the standard task. Decrements in number of matches at the outset of relearning (RL) were found to be related to the amount of OL. The present report is concerned with the effects of varying the amount of interpolated learning (IL) subsequent to some fixed amount of OL on the relearning of the standard task. There were 12 experimental groups, composed of male students. With two exceptions, the groups were the same as those used in analyzing the effects of different amounts of OL. Two new groups were added to insure a more adequate interpretation of the findings. TAB

N67-22523# State Univ. of Iowa, Iowa City.
FACILITATION AND INTERFERENCE IN PERFORMANCE ON THE MODIFIED MASHBURN APPARATUS. I: THE EFFECTS OF VARYING THE AMOUNT OF ORIGINAL LEARNING
Don Lewis, Dorothy E. McAllister, and Jack A. Adams [1966] 25 p refs
(Contract N9onr-93801)
(SDC-938-1-1; AD-643406) CFSTI: HC$3.00/MF$0.65

The acquisition of skill on the standard Mashburn task facilitated and also interfered with the subsequent learning of the reversed task. The signs of both facilitation and interference were clearly present at the outset of reversed practice and persisted in recognizable form through several trials. The amounts of proactive facilitation and interference displayed during IL (interpolated learning) were not found to be positively related to the amount of OL (original learning) on the standard task. Only one of the 12 experimental groups yielded clear evidence of the functioning of retroactive facilitation. The experimental groups, especially those receiving 3 or 5 days of OL and IL, showed conspicuous signs of retroactive interference during the early stages of relearning. Results for the control groups showed that the decreases in matches and increases in errors displayed by the experimental groups at the outset of relearning were the result of retroactive interference and not the result of the mere passage of time from the last OL trial to the first RL trial nor of such intangible factors as boredom and fatigue. Author (TAB)

N67-22536# Naval Submarine Medical Center, Groton, Conn.
TEN POINT WEIGHTING WITH THE IBM-805 TEST SCORING MACHINE
James W. Parker and Joseph A. Auwood 8 Dec. 1966 8 p refs
(MEMO-66-18; AD-646305) CFSTI: HC$3.00/MF$0.65

Multiple choice tests designed to assess individual differences in achievement in various training situations are in common usage in the Navy. Most test scoring machines are designed to score test items with four or fewer response alternatives. Often, however, it is desirable to include a wider gamut of choices to evaluate differences in response to a particular content area tapped by the test item. This paper describes a straight-forward method of preparing scoring templates for the IBM-805 Test Scoring Machine to provide cumulative scores from 10-choice differentially weighted response alternatives. Author (TAB)

N67-22542# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EFFECT OF DISTANCE BETWEEN AN INDICATOR AND ITS CORRESPONDING CONTROL UPON CONTROL ACTIVATION TIME
Earl D. Sharp and Edwin H. Sasaki Jan. 1967 9 p
(AMRL-TR-67-6; AD-645753) CFSTI: HC$3.00/MF$0.65

The study was designed to determine if variations in the distance between a control and its associated display affected control activation time. The time required to activate toggle switches was measured with control-display separations of 1.27 cm(0.5 in.), 3.81 cm(1.5 in.) and 6.34 cm(2.5 in.). The mean control activation times and their associated standard deviations were not differentially affected by the control-indicator distances used in the study. Author (TAB)

N67-22543# Wakoff Research Center, Staten Island, N. Y.
INTERPERSONAL RELATIONS AND MILITARY PERFORMANCE
Sheldon Blackman, Kenneth M. Goldstein, and Donald J. Collins Nov. 1966 101 p refs
(Contract DA-49-193-MD-2538)
(Rept.-3; AD-646048) CFSTI: HC$3.00/MF$0.65

It is hypothesized that an individual's performance is related to his perception of the support available to him from others. This support may be in two forms: (1) emotional support, or (2) being supplied with goods and services. The basic premise underlying the theoretical position is that when an individual feels he has support available to him from other people, he is better able to tolerate stress and his performance will be maintained at a high level. Therefore, the aspect of the interpersonal relationship focused on in this study is the feeling of an individual that he has others to call on should he need their support. In basic training one important source of support is from squadmates. This research is a study of the effects on performance of the relationships of recruits to their squadmates. TAB

N67-22644# George Washington Univ., Washington, D. C. Human Resources Research Office.
THE IMPORTANCE OF TRAINING REQUIREMENTS INFORMATION IN THE DESIGN AND USE OF AVIATION TRAINING DEVICES
Wallace W. Prophet Dec. 1966 11 p Presented at the Flight Safety Found. 16 Ann. Intern. Air Safety Seminar, Athens, Nov. 1963 /Its Profess. Paper 8-66
(Contract DA-44-188-ARO-2)
(AD-645961) CFSTI: HC$3.00/MF$0.65

It is believed that observance of the following guidelines can result in effective devices that allow increases in efficiency and economy in training, as well as real increases in flight safety: (1) Training devices should be built only after careful analysis of

the training requirements. (2) Analysis of training requirements should be primarily psychological rather than engineering in nature. (3) Determination of device characteristics should be oriented toward providing task fidelity, with physical fidelity being provided only as necessary to task fidelity. (4) Synthetic training programs should receive as careful consideration in their development as do the trainers themselves. (5) Devices and synthetic training programs should be tested for training effectiveness just as aircraft are tested. (6) Training devices and simulators can provide an effective means of reinforcing infrequently occurring behaviors.
Author (TAB)

N67-22550# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
A PERSONAL FM/FM BIOTELEMETRY SYSTEM
George E. Bergey, William C. Sipple, William A. Hamilton, and Russell D. Squires 23 Nov. 1966 36 p refs
(NADC-MR-6624; AD-645665) CFSTI: HC$3.00/MF$0.65

The report describes an FM/FM biotelemetry system capable of monitoring respiration, temperature, EEG and EKG and is easily converted to telemeter additional channels of data as required. This system is a combination of standard components, pasteless electrodes and relatively uncomplicated circuitry incorporated in a quick-donning comfortable garment to facilitate easy connection of the subject to the system.
Author (TAB)

N67-22562# Melpar, Inc., Falls Church, Va.
ANALYSIS OF CRYOGENICALLY TRAPPED TRACE CONTAMINANTS BY IONIZING GAS CHROMATOGRAPHY Final Report, 15 Oct. 1965–15 Jan. 1967
Hannibal S. de Schmertzing, Sol S. Nelson, and Harold G. Eaton 15 Jan. 1967 21 p
(Contract AF 41(609)-2958)
(AD-645714) CFSTI: HC$3.00/MF$0.65

The purpose of the work was to determine quantitatively the concentration of micro contaminants in a sealed environmental system. The separation and identification of the cryogenically trapped trace contaminants was accomplished with liquid gas chromatography using a flame ionization detector. Forty sets of samples were analyzed, each set consisting of 3 cylinders, trapped at Brooks AFB. The compounds contained in the sample cylinders were identified by their elution time from a column and the amount measured with the aid of peak areas. The response characteristics of the chromatograph were calculated from response obtained with standard mixtures. The forty sample sets were composed of 9 samples from a manned simulator run conducted in October-November, 1965; 30 samples from a similar run conducted in March-April 1966, and one sample set consisting of trapping efficiency runs.
Author (TAB)

N67-22575# General Electric Co., Santa Barbara, Calif. Tempo.
COMPUTER AUGMENTED LEARNING—A SURVEY
J. Kindred 16 Nov. 1966
(Rept.-66TMP-55; AD-645121) CFSTI: HC$3.00/MF$0.65

The report contains a description and summary of computer augmented learning devices and systems. The devices are of two general types: programmed instruction systems based on the teaching machines pioneered by Pressey and developed by Skinner, and the so-called docile systems that permit greater user-direction with the computer under student control. Even sympathetic criticisms by practitioners reveal limited understanding of the psychology of learning and knowing, expose potential restrictions to adequate selection of computer-based curricula, and recognize technical hazards that impede the development of effective computerized educational tools.
Author (TAB)

N67-22585# University of Southern Calif., Los Angeles. Dept. of Psychology.
TRAINING OBJECTIVES FOR CORRECTIVE MAINTENANCE OF THE AN/URC-32 TRANSCEIVER Technical Report, Aug. 1966
Joseph W. Rigney, Edward T. Langston, Ralph B. Macaruso, and Robert Fromer Aug. 1966 112 p refs
(Contract Nonr-228(22))
(TR-48; AD-646027) CFSTI: HC$3.00/MF$0.65

This report contains a detailed description of the criterion tasks required for the corrective maintenance of the AN/URC-32 transceiver. These represent terminal behaviors that graduates of a Class C AN/URC-32 School should be able to perform. The specification of these criterion behaviors is a first step in the development of a training program. The description is organized in terms of six corrective maintenance requirements: system state recognition, fault localization, circuit isolation, component isolation, maintenance adjustments, and repair. The tasks necessary to fulfill these requirements, the general skills in the use of test equipment, and the acceptable degrees of accuracy for performing the major task are described. The steps which must follow this first step in gaining control over training as a process are outlined, and recommendations for the use of these training objectives are made.
TAB

N67-22590# Library of Congress, Washington, D. C. Aerospace Technology Div.
HIGHLIGHTS OF SOVIET BIOASTRONAUTICS AT THE 17TH IAF CONGRESS IN MADRID
Boris Mandrovsky *In its* Foreign Sci. Bull., Vol. 2, No. 12 Dec. 1966 p 24–37 refs (See N67-22587 11-05) CFSTI: HC $3.00/MF$0.65

An indication of future trends and summary data on several aspects of the Soviet space program are presented. The Kosmos-110 experiment, in which two dogs were orbited for 22 days and brought back to earth, showed that it required eight or nine days for the dogs to adjust their motor coordination to weightlessness. No noticeable pathological changes in the cardiovascular system occurred during the flight. Pharmacological preparations used in enabling man to withstand various space flight stresses are listed. Acceleration experiments which relate the problem to hypoxia are discussed. Cabin atmospheres and spacesuit problems are assessed, and it is reported that Soviet scientists are considering high oxygen atmospheres for future space flights. Maneuvering and orientation problems related to extravehicular activity are mentioned. In discussing partially closed ecological systems, interest centered on (1) the use of higher plants as a link in potential ecosystems; (2) the problem of treating human wastes and other life support system byproducts; and (3) an aerobic method of biological mineralization. The basic parameters for biotelemetry measurements are defined.
M.G.J.

N67-22615# American Inst. for Research, Pittsburgh, Pa. Inst. for Performance Technology.
AN EXPERIMENTAL ANALYSIS OF SELECTED PROBLEMS OF LARGE-SHELTER MANAGEMENT, ENVIRONMENTAL THREAT, AND SMALL-SHELTER HABITABILITY UNDER CONDITIONS OF STRESS Final Report
John F. Hale, Donald E. Meagley, Robert W. Smith, and Robert L. Davis Sep. 1966 220 p refs
(Contract OCD-PS-64-57)
(AIR-D93A(1&2)-9/66-FR; AD-645343) CFSTI: HC $3.00/MF $0.65

The research program was composed of three major efforts: (1) the initial development of and the feasibility testing of a large-shelter contingency game for use in the analysis of problems associated with large-shelter management, (2) the development of techniques for and the feasibility of the use of an underwater shelter as a method for producing an experimental analog of the

threat associated with actual shelter habitability, and (3) the design and execution of four 24-hour habitability studies to investigate the effects of increased realism of a shelter stay, in terms of the number and range of problems presented to the shelterees and the realistic representation of other aspects of the expected shelter environment under the condition of nuclear attack. Results of these efforts indicated that (1) the contingency game is a meaningful and feasible technique by which to explore problems of large shelter management, (2) the condition of being underwater appeared to produce anxiety which was reflected in part, by marked attentiveness to atmospheric monitoring tasks in the shelter, an attentiveness that appeared to be greater than that exhibited to the analogous task of radiological monitoring in the shelter studies, and (3) some knowledge of the concept of dual-purpose shelters is desirable on the part of the public; EBS programming should be continuous; authoritarian leadership is most effective, but there are some potentially dangerous aspects in its use; and concern over the maintenance of group discipline at shelter exit is definitely called for. Author (TAB)

N67-22870# George Washington Univ., Washington, D. C. Human Resources Research Office.

THE EFFECT OF PROGRAMMED INSTRUCTION RESPONSE CONDITIONS OF ACQUISITION AND RETENTION

Thomas J. McCrystal and T. O. Jacobs Dec. 1966 41 p refs

(Contract DA-44-188-ARO-2)

(TR-66-20; AD-646347) CFSTI: HC $3.00/MF $0.65

The objective was to evaluate the effect on criterion scores of programed instruction requiring subjects either to write or not to write their responses, under either constructed or prompted conditions, with military tactics as the content. One hundred and twenty Infantry lieutenants in groups of 30 used the programed booklet instruction with the four response conditions: constructed-overt, constructed-covert, prompted-overt, and prompted-covert. Two control groups were also tested. Although test scores from conventional lecture and programed instruction methods did not differ significantly, the lecture method required twice the average training time of the fastest programed method. The similarity in effectiveness resulting from the disparate response conditions suggests that, for content of this nature and length, constructed responses (either overt or covert) may be dispensed with in favor of prompted-covert responses, which require less learning time without compromising the training effectiveness of programed instruction. TAB

N67-22884# Illinois Univ., Urbana. Coordinated Science Lab.

THE EFFECT OF COMPLEXITY OF NATURAL LANGUAGE MEDIATORS AND THE ASSOCIABILITY OF PAIRS ON PAIRED-ASSOCIATE LEARNING

Alexander J. Wearing and William E. Montague Jan. 1967 19 p refs

(Contracts DA-28-043-AMC-00073(E); Nonr-3985(08))

(R-333; AD-645740) CFSTI: HC $3.00/MF $0.65

Natural language mediators (NLM) are widely used by Ss in paired-associate learning. Experiments which have documented their effect on learning have, however, largely ignored qualitative differences between them. Two large groups each learned a different CVC-word list after which they reported any NLMs they had used. Judges rated the complexity of NLMs using a scale developed by Martin, Boersma and Cox (1965) with different materials. The results agree with theirs in that complex NLMs produced fewer errors in learning. However, some categories on the scale were used infrequently which may indicate that, at least with highly meaningful material, a simpler dichotomous categorization (NLM or Rote) may be preferable. Author (TAB)

N67-22887# Naval Applied Science Lab., Brooklyn, N. Y.

ELECTROMAGNETIC RADIATION HAZARDS IN THE NAVY

C. Christianson and A. Rutkowski 24 Jan. 1967 28 p

(TM-3; AD-645696) CFSTI: HC $3.00/MF $0.65

The many and varied sources of electromagnetic hazards in todays modern Navy are described in this paper. High power communication transmitters, radars, lasers and radar power tubes produce hazards ranging from high voltage shock to ionizing radiation. Effects on man are thermal (e.g. retinal and skin burns) and athermal (e.g. pearl-chain formation). Body tissue absorption of RF radiation, heating, tolerance dosage and safety limits are discussed. Safe distances from present Naval radars, and future increases in radar power are indicated. Characteristics of protective devices (Radar Suit, Radar Goggles, High Voltage Insulator Links for Ships Cranes, X-Ray Hazard Meter) developed at NASL are described. Remaining problems and some unusual effects (RF Hearing) are mentioned. Author (TAB)

N67-22718# Royal Aircraft Establishment, Farnborough (England).

SOME CHARACTERISTICS OF THE HUMAN OPERATOR AND HIS MATHEMATICAL REPRESENTATION IN THE TRACKING ROLE

W. F. Fielding Aug. 1963 29 p refs

(RAE-TN-WE-38) CFSTI: HC $3.00/MF $0.65

The physiological factors which affect a human operator's performance of a tracking task are discussed, together with the limitations of mathematical representations of the human operator, sufficient to enable a nonpsychologist to obtain a reasonable picture of how a human operator works. Factors affecting control design, system response and display are discussed, together with some suggestions for evaluation of the constants in the operator's equation. A bibliography of some relevant papers is given as an appendix. Author

N67-22793# Queens Univ., Belfast (Northern Ireland).

THE ADDITION OF PERIPHERAL VISION TO THE ARTIFICIAL HORIZON

K. J. Holden Aeronautical Research Council, Jun. 1963 14 p refs

(ARC-CP-731; ARC-24916) CFSTI: HC $3.00/MF $0.65

This report describes an attempt to make instrument flying easier. Horizontal lines were placed on either side of the pilot at the periphery of his field of view. They move up and down differentially as the aircraft rolled and together as it pitched, simulating the apparent motion of the real horizon. Tested in a fixed cockpit these lines or 'side-bars' did not completely succeed in creating the illusion of a stationary horizon. However, the pilot's performance as regards accuracy was much improved in tasks requiring simultaneous monitoring of roll and pitch. Author

N67-22878*# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

SPACE-CABIN ATMOSPHERES. PART III: PHYSIOLOGICAL FACTORS OF INERT GASES

Emanuel M. Roth Washington, NASA, 1967 135 p refs Prepared for NASA

(NASA-SP-117) CFSTI: HC $3.00/MF $0.65 CSCL 06K

The physiology of inert gases in space cabins is considered from an operational viewpoint. A review of the physical chemistry of inert gases covers their atomic structure, physical and biochemical properties, and chemical reactions. Also discussed are the prime role of inert gases in decompression sickness, the metabolic effects of inert gases, the engineering implications of using inert gases in space cabins, and the role of inert gas physiology in selecting space cabin atmospheres. R.N.A.

N67-23042# George Washington Univ., Washington, D. C. Human Resources Research Office.

THE PERFORMANCE OF GROUND OBSERVERS IN DETECTING, RECOGNIZING, AND ESTIMATING RANGE TO LOW-ALTITUDE AIRCRAFT

A. Dean Wright Dec. 1966 35 p refs
(Contract DA-44-188-ARO-2)
(TR-66-19; AD-645537) CFSTI: HC $3.00/MF $0.65

The purpose of the test was to determine mans capability to visually detect, recognize, and estimate range to low-altitude aircraft. Twenty-seven Army enlisted men served as observers. The results indicate that man can detect and recognize low-altitude aircraft at a considerable range under near-optimum field conditions. The value of binoculars for aircraft detection was found to be dependent upon (a) observer offset from the aircraft flight path, (b) accuracy of early warning, (c) aircraft speed, and (d) exhaust smoke trail characteristics of the aircraft. Under the test conditions employed, binoculars reduced the detection range on the most potentially threatening targets, high-speed, head-on jet aircraft. The data show that large range estimation errors occurred. Filmed simulation of the recognition task appears promising as a training tool. Author (TAB)

N67-23067# Stanford Research Inst., Menlo Park, Calif.
CHARACTERISTICS THAT DETERMINE SPEAKER RECOGNITION Final Report, 16 Sep. 1963–15 Sep. 1966
Frank R. Clarke, Richard W. Becker, and James C. Nixon Dec. 1966 75 p refs
(Contract AF 19(628)-3303)
(ESD-TR-66-636; AD-646135) CFSTI: HC $3.00/MF $0.65

Development and evaluation of three types of speaker-discrimination tests are discussed, including effects of various types of signal degradation upon human speaker-recognition performance and comparisons of various techniques for differentiating among speakers. Properties of three tests--a Four-Alternative Forced-Choice Test, an ABX Test, and a Same-Different Test--are described. Using these tests, it was found that effects of signal degradation upon speaker discrimination performance are small in comparison with effects of the same degradation upon intelligibility. It was found that various physical measures and psycho-physical scaling techniques provide information appropriate for discrimination among talkers. However, none of these techniques performed as well as human observers and provided little direct information regarding the characteristics used by human observers in discriminating among talkers. Author (TAB)

N67-23103# RAND Corp., Santa Monica, Calif.
LINGUISTIC RELATIVITY AND THE LANGUAGE LEARNING PROCESS
Robert M. Schwarcz Dec. 1966 14 p refs
(Contract AF 44620-67-C-0045; Proj. RAND)
(RM-5210-PR; AD-644929) CFSTI: HC $3.00/MF $0.65

A five-stage analysis of the language-learning process is presented, and an investigation is made of whether this analysis supports or contradicts the Whorfian hypothesis of linguistic relativity. The syntactic constructions of a language influence the types of conceptual relationship that the child perceives. Words and phrases grouped together by the conventions of the language have a determining effect on conceptual representations associated with them. This effect is somewhat mitigated by the transformational phase of language learning, which opens up the full range of stylistic devices available in a language, thus extending the number of percepts and concepts that may gain expression in that language. However, earlier preceptual and conceptual habits will probably persist throughout a persons adult life unless he is forced to change by some new experience, such as the mastery of a different language. Author (TAB)

N67-23113# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
STUDY OF EXTRAVEHICULAR PROTECTION AND OPERATIONS
P. Iribe and J. A. Lieske Jul. 1966 133 p refs
(Contract NOw-62-0604-c)
(APL-TG-841; AD-644909) CFSTI: HC $3.00/MF $0.65

The report is a study of the requirements placed on extravehicular protection and operation devices by the orbital environment and contemplated orbital missions. The orbital missions studied cover the period 1970-1978 to the extent that they are presently defined. The conclusions favor a suited astronaut supported by propulsion, communication and working aids (non-anthropomorphic suits were not included in this study). Concepts of vehicles satisfying the requirements developed are presented as is the concept of a modularly assembled device which can be modified to best suit specific mission requirements. Author (TAB)

N67-23129# Illinois Univ., Urbana. Group Effectiveness Research Lab.
THE EFFECT OF INTER-GROUP COMPETITION ON GROUP MEMBER ADJUSTMENT
Fred E. Fiedler 1966 17 p refs
(Contract DA-49-193-MD-2060)
(AD-645220) CFSTI: HC $3.00/MF $0.65

The paper briefly reviews research showing that competition among small face-to-face groups may also contribute to the individual group members adjustment and morale. While many of the studies were conducted with military units, the findings should apply equally well to industrial work groups. Author (TAB)

N67-23130# Vanderbilt Univ., Nashville, Tenn.
AFFECTIVE FACTORS IN THE STEREOSCOPIC PERCEPTION OF PERSONS AND OBJECTS
Gordon E. Kulberg and Carroll E. Izard Jun. 1966 40 p refs
(Contract Nonr-2149(03))
(TR-28; AD-645202) CFSTI: HC $3.00/MF $0.65

The study was designed to test the concept that there is a relationship between a persons feelings toward other people and his tendency to view human figures as opposed to objects when given the opportunity to look at one or the other. The subjects feelings toward others were measured by the FIRS+. The effect of immediate interpersonal feelings with the experimenter on the person-object perception was manipulated by treating some subjects negatively, some positively, and others with scientific aloofness. The perceptual task utilized an Engel type stereoscope and involved the presentation of a picture of an object to one eye and a picture of a male figure to the other. Perceptual predominance for the human or the object was measured by that picture seen first and the one seen the greatest amount of the time. The results did not support the predictions. There was no relationship between the FIRS+ scores and the number of human figures seen. The treatment by the experimenter did not influence the perceptual predominance. Author (TAB)

N67-23131# Vanderbilt Univ., Nashville, Tenn.
ON UNDERSTANDING AND PROMOTING HUMAN EFFECTIVENESS
Carroll E. Izard Oct. 1966 41 p refs
(Contract Nonr-2149(03))
(TR-29; AD-645203) CFSTI: HC $3.00/MF $0.65

Perhaps I have not done much more than state my claim to membership in the group that believes strongly in the possibility and desirability of change. I certainly agree with McClelland that such belief is a highly important factor in changing people and social institutions. I would go a bit further and say that such belief is in many cases essential to the process of change, though admittedly not so in every case. Also, I have expressed allegiance to the complex and difficult goal of understanding, via our science, and promoting, via our profession, human effectiveness--particularly in the interpersonal and social spheres. Within this broad area I have presented some theoretical formulations regarding the role of affect in personality and interpersonal functioning and its role in the process of change toward greater effectiveness. Effective functioning and change toward greater effectiveness involve the three processes of affect experiencing, affect differentiation, and

affect expression and the integration of these with motor and cognitive processes. The three affective processes were described and their optimal levels tentatively defined. The relationships of the three processes to adjustment and effective functioning were considered. Finally, I described some of the principles and procedures of the Feeling-Feedback exercise, one of the exercises in integrating affect and cognition in social interaction used in the Interpersonal Effectiveness Groups of the Vanderbilt Human Effectiveness Program. TAB

N67-23239# San Diego State Coll., Calif.
HUMAN FACTORS IN THE DESIGN OF AN OBSERVER'S KEYSET
P. S. Gallo, Jr. and J. R. Levine 14 Oct. 1966 40 p refs
(Contract N123-(953)55266A)
(NEL-1411; AD-645653) CFSTI: HC $3.00/MF $0.65

The report describes an investigation of the effects of changes in a number of design characteristics and other variables on operation with keysets used to record information in binary notation from stimulus displays that contain a maximum of five bits of information per stimulus. Principal result was a demonstration of superiority in transmission and error rates of five-key pattern entry over two-key sequential entry. Other variables tested were less significant. Author (TAB)

N67-23324*# RAI Research Corp., Long Island City, N. Y.
RESEARCH, DESIGN AND DEVELOPMENT OF AN IMPROVED WATER RECLAMATION SYSTEM FOR MANNED SPACE VEHICLES
S. B. Tuwiner Apr. 1966 62 p refs
(Contract NAS1-4373)
(NASA-CR-66323) CFSTI: HC $3.00/MF $0.65 CSCL 06K

This study was to develop a method and prototype equipment for the recovery of the water contained in urine while removing the salts in the form of a brine concentrate and destroying the organic components by converting them to nitrogen, carbon dioxide, and hydrogen. The two steps of the system are electrochemical conversion of the organic components and the recovery of the water by reverse osmosis separation employing a membrane stack at 1500 lbs./sq. in. The electrochemical conversion requires 457 watt-hrs. for each liter of urine. A neutral solution free of chlorine and oxidizable matter (COD) is produced by treating the solution with activated carbon and magnesium oxide. The membrane stack contains 10 circular membranes, 4 inches in diameter, a 3 inch diameter circle constitutes the surface which is available for reverse osmosis separation. The capacity of this stack is 18 liters per day. Potable water was produced by this unit from electrochemically treated urine. The indicated recovery is 90 per cent as a minimum. Phase separation is required for operation under zero G conditions. Author

N67-23327*# Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Labs.
LUNAR SAMPLE RECEIVING LABORATORY GLOVE SYSTEM Interim Monthly Progress Report, Oct. 1966-Jan. 1967
Feb. 1967 27 p
(Contract NAS9-5872)
(NASA-CR-65605; MPR-9) CFSTI: HC $3.00/MF $0.65 CSCL 05B

The report describes design and fabrication of two prototype one-atmosphere arm systems comprised of operational arms and a pair of overgloves. The system has a very low leak rate and is capable of performing in vacuum chambers maintained at a pressure of 10^{-8} Torr. Materials, test performances, and the initiation of quality assurance procedures are also discussed. K.W.

N67-23328* Environmental Research Associates, Randallstown, Md.
A STUDY OF THE PERFORMANCE OF AN ASTRONAUT DURING INGRESS AND EGRESS MANEUVERS THROUGH AIRLOCKS AND PASSAGEWAYS Final Phase I
Harry L. Loats, Jr. and G. Samuel Mattingly 31 Aug. 1966 66 p refs
(Contract NAS1-4059)
(NASA-CR-66340; ERA-64-8) CFSTI: $3.00 CSCL 05H

A time-displacement analysis using motion pictures was performed to assess experiments involving pressure-suited astronaut egress under balanced gravity conditions. A full scale airlock with three distinct hatch configurations and a cylindrical passageway was used at Langley Research Center. The experiments were performed in three modes: (1) ground/normal gravity; (2) water immersion/neutral buoyancy; and (3) aircraft/balanced gravity. Comparative parameters for the three modes were suit pressure, subject, and suit type. Egress maneuvers using the water immersion and aircraft modes could be correlated as regards psychological and operational considerations. The major dissimilarity of the ground tests was in the total times of egress and in discrete task performance times and modes, all due to mobility decrement caused by the pressure suit and by normal gravity effects. Valid experiments of egress under balanced gravity require water immersion tests backed up with a number of aircraft tests. Ground/normal experiments are additionally required for control and procedure determinations. K.W.

N67-23329* Environmental Research Associates, Randallstown, Md.
A STUDY OF THE PERFORMANCE OF AN ASTRONAUT DURING INGRESS AND EGRESS MANEUVERS THROUGH AIRLOCKS AND PASSAGEWAYS. VOLUME I: SUMMARY Final Phase II Report
Harry L. Loats, Jr., G. Samuel Mattingly, and C. E. Brush 30 Apr. 1965 17 p
(Contract NAS1-4059)
(NASA-CR-66341; ERA-65-3, Vol. I) CFSTI: $3.00 CSCL 05H

The performance characteristics of a pressure-suited astronaut during ingress-egress through a cylindrical, manually operated airlock were studied by water immersion simulation techniques. The buoyancy force induced by water displacement of a totally immersed subject was used to counteract his adjusted total weight to provide the simulated weightless environment. The subject performed a real-time ingress-egress maneuver as determined by functional task analysis of a representative mission. The following airlock operational characteristics were investigated by factorial replication: The effect of airlock geometry and volume on total performance. The effect of hatch geometry, diameter and operation direction on performance. The contribution of torque requirements, hardware placement and motion aids to the problems and procedures comprising ingress-egress and manned replenishment. Correlation to actual weightless conditions was provided by similarity comparison with experiments performed aboard zero gravity research aircraft. Author

N67-23342* Environmental Research Associates, Randallstown, Md.
A STUDY OF THE PERFORMANCE OF AN ASTRONAUT DURING INGRESS AND EGRESS MANEUVERS THROUGH AIRLOCKS AND PASSAGEWAYS. VOLUME II: TECHNICAL DISCUSSIONS
Harry L. Loats, Jr., G. Samuel Mattingly, and C. E. Brush 31 Apr. 1965 130 p refs
(Contract NAS1-4059)
(NASA-CR-66342; ERA-65-3, Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The performance characteristics of a pressure-suited astronaut during ingress-egress through a cylindrical, manually operated airlock were studied by water immersion simulation techniques. Position-velocity time profiles of the maneuvers were analyzed for three simulation modes: ground-normal gravity, aircraft-zero gravity, and water immersion-neutral buoyancy. Data for the following replicated parameters are presented: subject, suit type, suit pressure level, hatch configuration, hatch diameter, and hardware location. Demonstrations of the problems and procedures comprising the application of torque during ingress-egress, manual replenishment through the airlock, and the employment of external motion aids such as fixed bar and tethers were accomplished. A.G.O.

N67-23343* Environmental Research Associates, Randallstown, Md.
A STUDY OF THE PERFORMANCE OF AN ASTRONAUT DURING INGRESS AND EGRESS MANEUVERS THROUGH AIRLOCKS AND PASSAGEWAYS. VOLUME III: APPENDICES Final Report
Harry L. Loats, Jr., G. Samuel Mattingly, and C. E. Brush 31 Mar. 1965 43 p
(Contract NAS1-4059)
(NASA-CR-66343; ERA-65-3, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 05H

Subject anthropometric data, an experiment summary, a statistical analysis, subject/suit calibration data, and drag estimations are presented as supporting material to an astronaut performance study. Also included is a glossary of physiological and technical terms which are related to the ingress and egress experiments. A.G.O.

N67-23365# Florida State Univ., Tallahassee.
MODELS FOR PAIRED COMPARISONS
W. A. Thompson, Jr. and Jagbir Singh Jul. 1966 16 p refs
(Contract Nonr-988(08); Grant NSF-GP-3807)
(M-111; ONR-TR-21; AD-639657) CFSTI: HC $3.00/MF $0.65

A central concept in this paper is that of linear model. A model is called linear if the frequency probability with which a subject reports the stimulus X sub 1 as greater than X sub 2 has the form H (t (X sub 1)-t (X sub 2)). Interrelations among various models for paired comparisons are studied. The Thurstone, Bradley–Terry, and Scheffe models are treated as special cases of the general linear model. It is shown that all of these special cases introduce a concept of 'psychological distance between stimuli.' The increase or decrease of the probability of detecting the larger stimulus for linear-models is shown to depend primarily on t rather than H. The uniqueness of the linear representation of a Bradley–Terry model is discussed. A final section proposes a general model allowing for the response of no apparent difference. Author (TAB)

N67-23367# Florida State Univ., Tallahassee. Dept. of Statistics.
THE USE OF LIMIT THEOREMS IN PAIRED COMPARISON MODEL BUILDING
W. A. Thompson, Jr. and Jagbir Singh Jun. 1966 21 p refs
(Contract Nonr-988(08); Grant NSF GP-3807)
(M-111; ONR-TR-20; AD-639656) CFSTI: HC $3.00/MF $0.65

The Thurstone and the Bradley-Terry models, both initially advanced on intuitive grounds, have proved useful in the analysis of paired comparisons. The psychological meaning of these models and their relation to one another is unclear, but they fit data. Stevens has observed that there may be two basic mechanisms of discrimination (1) additive and (2) substitutive. We advance two corresponding mathematical models: that experienced sensation is (1) the sum of a large number of independent signals and (2) the maximum of a large number of independent signals. These assumptions yield (1) Thurstones model and (2) the model of Bradley-Terry. Psychological interpretations of the various parameters, in terms of sensation, present themselves in a natural manner. Thus this paper presents a theory which unifies and interprets two paired comparison models that have proved useful in fitting experimental data. Author (TAB)

N67-23489# Joint Publications Research Service, Washington, D. C.
WHAT SHOULD THE COSMONAUTS BREATHE ?
V. Stantso 2 Feb. 1967 6 p ref Transl. into ENGLISH from Khim. i Zhin (Moscow), v. 2, no. 12, Dec. 1966 p 7–9
(JPRS-39740; TT-67-30388) CFSTI: HC $3.00/MF $0.65

A nondetailed comparison was made of various spacecraft cabin atmospheres. Advantages and disadvantages were given in terms of astronaut protection and life support efficiency, and in terms of the various problems encountered in spacecraft design. C.L.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-22087# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
PHYSICO-CHEMICAL STUDIES OF Fe–Cr–Al-CLAD FUEL SYSTEMS
H. S. E Edwards and K. M. Bohlander *In its* High Temp. Mater. Program 30 Sep. 1966 p 105–109 refs (See N67-22091 11-22) CFSTI: HC 3.00/MF $0.65

Diffusion couples of Al, Cr, and Fe were fabricated and heat treated at 1000°C for 100 and 1000 hours. Cr diffused and formed a greater number of phases than Fe. Phase studies of Al–Cr–Fe–U fuel elements show extensive solubility of Al, Cr, and Fe in U but little solubility of U in the Al–Cr–Fe cladding alloys. NSA

N67-22091# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 IN POTENTIAL MELTDOWN ENVIRONMENTS
J. F. White *In its* High-Temp. Mater. Program 30 Sep. 1966 p 143–155 refs (See N67-22061 11-22) CFSTI: HC $3.00/MF $0.65

Results of dynamic steam corrosion tests on Zircaloy-4-clad UO_2 to determine amount of oxide, O_2-saturated metal, and unaltered metal existing at various temperatures, are reported. Isothermal steam corrosion tests on Zircaloy, Valoy, and on mild steel indicate that reactions are similar to those of 304 stainless steel. Thermal conductivity of Zircaloy-4 was measured at 1500°C and electric resistivity to 1400°C. NSA

N67-22095# National Bureau of Standards, Washington, D. C.
HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, OCTOBER–DECEMBER 1966 Bibliography
J. J. Diamond, ed. Basel (Switzerland), Intern. Union of Pure and Appl Chem., Dec. 1966 77 p refs *Its* Vol. 1966, No. 4

The bibliography includes: measuring instruments and devices for achieving temperatures above 1500°C; physical and chemical properties at temperatures below and above 1000°C of metallic and nonmetallic materials with melting points below and above 1500°C; phase equilibria data; and reactions at temperatures above 1000°C. N.E.N.

N67-22099# Eidgenossische Technische Hochschule, Zürich (Switzerland).
ANION UNIPOLYMERIZATION OF CYCLOHEXADIENE-1,3 [DIE ANIONISCHE UNIPOLYMERISATION VON CYCLOHEXADIEN-1,3]
Eleuterio Pascual y Montano (Ph.D. Thesis) 1965 69 p refs In GERMAN
(Rept.-3742) CFSTI: HC $3.00/MF $0.65

The unipolymerization with alkali metal aromatic complexes was investigated, and the dependence of the degree of polymerization and the exchange on monomer concentration and on the monomer-initiator ratio was determined. A chain transfer with the monomers was observed to occur in which a new chain may be started by the carbanions that are formed during the transfer. The tendency for chain transfer depends on the presence of an anti-ion and it increases in the order Li, Na, K. The results were not affected by the form in which the initiator was introduced. The use of butyl lithium as initiator proved that the solvent strongly affects the polymerization processes of cyclohexadiene. The results were verified by means of light scattering measurements. The structure of the resulting polymers was studied from IR and NMR spectra.
Transl. by K.W.

N67-22127# Eidgenossische Technische Hochschule, Zürich (Switzerland).
INVESTIGATION OF THE PRODUCTION AND THERMAL STABILITY OF METAL CARBAMATES [UNTERSUCHUNGEN ZUR DARSTELLUNG UND THERMISCHEN STABILITAET VON METALLCARBAMATEN]
Albert Sommerauer (Ph.D. Thesis) 1965 78 p refs In GERMAN
(Rept.-3778) CFSTI: HC $3.00/MF $0.65

Described is the preparation of the following metal carbamates: Calcium (II), aluminum (III), zinc (II), gallium (III), nickel (II), copper (II), and uranium (VI). Results of various thermodynamic studies on the coordination properties of the carbamate ion in reactions with solids are evaluated.
Author

N67-22128# Eidgenossische Technische Hochschule, Zürich (Switzerland).
CARBAMATE AND DIMETHYLCARBAMATE FROM TRANSITION METALS [CARBAMATE UND DIMETHYLCARBAMATE VON UEBERGANGSMETALLEN]
Jean-Jacques Salzmann (Ph.D. Thesis) 1965 131 p refs In GERMAN
(Rept.-3783) CFSTI: HC $3.00/MF $0.65

Various dimethyl carbamates of three- valence chromium and cobalt, as well as of two valence chromium, cobalt, nickel, copper, and zinc were obtained and evaluated. Observed were their spectroscopic and magnetic properties, their thermal stability, and some reactions with unsaturated bases.
Transl. by G.G.

N67-22153# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN APPLIED CHEMISTRY
16 Jan. 1967 32 p refs Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 38, no. 7, Jul. 1966
(JPRS-39538; TT-67-30188) CFSTI: HC $3.00/MF $0.65

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N67-22154# Joint Publications Research Service, Washington, D. C.
THE CATION-EXCHANGE METHOD FOR RECOVERY OF AMMONIA FROM SPENT SULFITE LIQUOR
L. Ioffe *In its* Soviet Res. in Appl. Chem. 16 Jan. 1967 p 1–7 refs (See N67-22153 11-06) CFSTI: HC $3.00/MF $0.65

In the cation-exchange method of ammonia recovery from spent sulfite liquor, the concentration of ammonia in the regenerated bisulfite solution is directly proportional to the hydrogen ion concentration in the initial regenerating aqueous SO_2 solutions. The hydrogen ion concentration in the SO_2 solutions is also directly proportional to the total degree of base recovery from the sulfite liquor. It is concluded that this established relationship of the cation concentration can exist in all ion-exchange processes in which a strongly acid cationite is regenerated with a weak acid.
A.G.O.

N67-22155# Joint Publications Research Service, Washington, D. C.
THE SEPARATION OF SULFURIC ACID FROM ANTHRAQUINONE SULFONATION PRODUCT WITH ION-EXCHANGE RESIN
Yu. A. Kolesnik and V. V. Kozlov *In its* Soviet Res. in Appl. Chem. 16 Jan. 1967 p 8–12 refs (See N67-22153 11-06) CFSTI: HC $3.00/MF $0.65

The feasibility of removing appreciable amounts of sulfuric acid from sulfonation products obtained by sulfonation of anthraquinone, by means of ionites, is demonstrated. In experiments performed under static and dynamic conditions, the extraction of sulfuric acid from solutions containing 10–12% H_2SO_4 and 15–25% anthraquinone was studied. Results indicate that the lowest limit of sulfuric acid concentration is 4.5–5%, and that this limit does not depend on the initial concentration.
A.G.O.

N67-22156# Joint Publications Research Service, Washington, D. C.
COMPARATIVE CHARACTERISTICS OF SULFOCATIONITES ON TWO DIFFERENT BASES
A. I. Pokrovskaya and V. S. Soldatov *In its* Soviet Res. in Appl. Chem. 16 Jan. 1967 p 13–15 refs (See N67-22153 11-06) CFSTI: HC $3.00/MF $0.65

A comparative description is presented of the properties of two ionites which have equal exchange capacities. Based on the results of selectivity investigations involving the exchange of Li^+, Na^+, and K^+ ions for H^+ ions, it is shown that the nature of the polymer base has an appreciable influence on the selective properties of sulfacationites.
A.G.O.

N67-22157# Joint Publications Research Service, Washington, D. C.
INFLUENCE OF THE NUMBER OF CROSSLINKS AND CERTAIN OTHER FACTORS ON THE THERMAL STABILITY OF SULFOCATIONITE KU-2 IN TERTIARY AMYLENES

P. Ye. Tulupov *In its* Soviet Res. in Appl. Chem. 16 Jan. 1967 p 16–20 refs (See N67-22153 11-06) CFSTI: HC $3.00/MF $0.65

The effect of KU-2 resin divinylbenzene content on its thermal stability in an organic medium is examined. In addition, the effect of grain size, degree of refinement, and the ratio of the resin to the organic liquid on KU-2 cationite heat resistance is analyzed. Results show that brief heating in the tertiary amylene medium and increase of divinylbenzene content in the KU-2 resin produces a cationite desulfuration rate increase. It is also demonstrated that the process of thermal desulfuration of KU-2 cationite in isoamylenes proceeds in the entire volume of the grain and is controlled not by the diffusion processes, but by the chemical transformation itself. A.G.O.

N67-22158# Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE EQUIVALENT WEIGHT OF ORGANIC COMPOUNDS BY THE ION-EXCHANGE METHOD

G. S. Libinson and Ye. M. Savitskaya *In its* Soviet Res. in Appl. Chem. 16 Jan. 1967 p 21–24 ref (See N67-22153 11-06) CFSTI: HC $3.00/MF $0.65

The ion exchange method for determination of equivalent weights is applied to the following organic compounds: (1) antipyrine red dye, (2) kanamycin A, and (3) florimycin. The values obtained from this study differ from the calculated values by not more than 4%. Thus, the results indicate that the ion exchange method can be used for determining equivalent weights and ion valences along with the already existing methods. Author

N67-22173*# General American Transportation Corp., Niles, Ill. Research Div.

RESEARCH AND DEVELOPMENT STUDY RELATED TO THE SYNTHESIS OF FORMALDEHYDE FROM CO_2 AND H_2 Quarterly Progress Report, Aug.–Oct. 1966

P. Budininkas, R. W. Ferris, and G. A. Remus Oct. 1966 32 p refs

(Contract NAS2-3889)

(NASA-CR-73070-1; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The results of a general literature survey, and a review of the methods of formaldehyde synthesis are presented. The synthesis procedures revealed in the search are: (1) direct formation of formaldehyde; (2) formation of methanol with subsequent conversion to formaldehyde; and (3) production of methane which can be then oxidized to formaldehyde. Each method is discussed with respect to the advantages and disadvantages in space conditions and limitations. The oxidation of methane to formaldehyde was considered the most promising, and details are given on the general method, using solid catalysts, and using gaseous catalysts. Included are extensive tables of references for these latter methods. N.E.N.

N67-22174*# General American Transportation Corp., Niles, Ill. Research Div.

RESEARCH AND DEVELOPMENT STUDY RELATED TO SYNTHESIS OF FORMALDEHYDE FROM CO_2 AND H_2 Quarterly Progress Report, Nov. 1966–Jan. 1967

P. Budininkas, R. W. Ferris, and G. A. Remus Jan. 1967 12 p refs

(Contract NAS2-3889)

(NASA-CR-73071-11; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The activities were concerned with (1) selection of solid catalysts and a correlation of their activities for the oxidation of methane to formaldehyde with their chemical and physical properties, (2) construction of an experimental system for methane oxidation to formaldehyde and the development of experimental procedures, and (3) testing solid catalysts and investigating the effects of variables such as temperature, feed gas composition, and space velocity on the yields of formaldehyde. The best results were obtained using an etched silica tube as the catalyst with a maximum formaldehyde yield ranging up to 0.7% of the methane in the feed gas. Author

N67-22223# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS, VOLUME 6 Annual Report, 1964–1965

Oct. 1966 405 p refs Transl. into ENGLISH of Nippon Hoshasen Kobunshi Kenkyu Kyokai Nenpo (Osaka), v. 6, 1964–1965 p 1–322

(AEC-TR-6806) CFSTI: HC $3.00/MF $0.65

Articles on dose measurements of beta beams, irradiation effects on electrical conductivity of organic material, radiation induced polymerizations, and radiation chemistry reactions are presented. For individual titles see N67-22224–N67-22256.

N67-22232# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

STUDIES ON RADIATION INDUCED IONIC POLYMERIZATION. I: POLYMERIZATION OF STYRENE IN SOLUTION AT LOW TEMPERATURE

Katsuji Ueno, Hitoshi Yamaoka, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 89–99 refs Presented at the 12th Ann. Meeting of the Polymer Soc., Tokyo, May 1963 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The radiation-induced ionic polymerization of styrene at −78°C has been studied in various solvents. Cationic polymerizations occur not only in methylene chloride, but also in carbon disulfide, ethylbromide and monofluorotrichloromethane. It is concluded that initiating species are derived neither from the acid formed by radiolysis of solvents nor solely by the proton transfer from solvents. From consideration of the G_i value, a mechanism is found in which most of the energy absorbed in solvent transferred to styrene is supposed. The G_i value obtained assuming no chain transfer is $0.1 \approx 0.2$, which agrees well with the G_i of the free ion previously reported. The relationship between dielectric constant of solvent and kinetic results of this polymerization is not so clear as for the conventional cationic polymerization. Author

N67-22233# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

STUDIES ON RADIATION INDUCED IONIC POLYMERIZATION. II: POLYMERIZATION OF ISOBUTENE AND COPOLYMERIZATION OF ISOBUTENE WITH STYRENE AT LOW TEMPERATURE

Katsuji Ueno, Hitoshi Yamaoka, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 100–112 refs Presented at the 12th Polymer Meeting, Nagoya, Japan, Nov. 1963 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The radiation-induced polymerization and copolymerization of isobutene with styrene have been studied in several solvents at −78°C. The rates of polymerization of isobutene in CH_2Cl_2, $CHCl_3$ and n-hexane have similar values, but in CS_2 a higher value is obtained. It is concluded that no relationship exists between the dielectric constant of and the rate of polymerization, and that the growing chain is a free ion ($G_i = 0.1 \approx 0.2$). Monomer reactivity ratios in the copolymerization of isobutene with styrene appear to be similar to those obtained in the case of conventional cationic polymerization. The radiation-induced polymerization rates for several monomers in CH_2Cl_2 at −78°C is as follows: Isobutene >

Styrene > p-Methoxystyrene > Isoprene > α-Methylstyrene > Isobutylvinylether > 2-Chloroethylvinylether > β-Propiolactone. Author

N67-22234# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

STUDIES ON RADIATION INDUCED IONIC POLYMERIZATION. III: POLYMERIZATION OF STYRENE AT ROOM TEMPERATURE

Katsuji Ueno, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 113–138 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The radiation-induced polymerization of styrene in an extremely dry system was studied at room temperature with sodium-potassium alloy as a drying agent. The kinetic results obtained were very different from those previously reported in which the radical reaction was predominant. A radical mechanism is precluded in a dry system for the following reasons; (1) The addition of a small amount of water and ammonia reduced the rate of polymerization (Rp). (2) The activation energy for Rp was nearly zero between −20° and +80°C. (3) The Rp was proportional to (dose rate)$^{0.8\sim1.0}$, while the molecular weight was independent of dose rate. Copolymerizations of styrene with α-methylstyrene and with isobutyl vinylether were carried out, and the results suggest a cationic mechanism as well as a remarkable retardation of Rp by added NH_3 and Et_2O. Radical scavengers such as DPPH and O_2 also retarded polymerization. The existence of an ion radical in the initiation step is supposed for the effect of above mentioned scavengers. In an extremely dry system, G (apparent initiation) is found to have a high value, which may be attributed to a frequent monomer chain transfer. The polymerization mechanism based on free ions is described in detail. Author

N67-22235# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

STUDIES ON RADIATION INDUCED IONIC POLYMERIZATION. IV: POLYMERIZATION OF STYRENE IN SOLUTION AT ROOM TEMPERATURE

Katsuji Ueno, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 139–150 refs (See N67-22223 10-06) CFSTI: HC $3.00/MF $0.65

The radiation-induced polymerization of styrene in an extremely dry system was studied in methylene chloride and toluene solution at room temperature. Under conditions of rigorous drying, higher G(−m) values were obtained than under normal conditions. Molecular weights of polystyrene formed in methylene chloride are higher than those obtained in bulk polymerization, suggesting a strong confirmation of a cationic mechanism. Polystyrene obtained in methylene chloride at 10°C contained less than 0.3 chlorine atoms per polymer molecule. In the case of polymerization in toluene, the decrease in molecular weights of polystyrene with increase of solvent concentration can be explained by chain transfer to toluene. Author

N67-22236# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

THE STUDY OF RADIATION CHEMISTRY BY THE MEASUREMENT OF ELECTRIC CONDUCTIVITY. II.

Kanae Hayashi, Torao Takagaki, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 151–158 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Ionic species formed by the γ-ray irradiation process were studied on cyclohexane, cyclohexene, benzene, and ethylbenzene at room temperature by the electric conductivity measurements. Ion drift mobilities, decay constants, G values of free ion formation and lifetimes of each compound were determined experimentally. Ion drift mobility of the anion is larger than that of the cation in vacuum, and the relation between electric conductivity and irradiation dose rate is different from that expected by Allen's kinetics. The G value for the relatively low dose rate irradiation was in the order of 10^{-2} to 10^{-3}, and aliphatics compounds had larger values than aromatics. The lifetimes of free ions are in the order of a second because of their low concentrations. Author

N67-22237# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

RADIATION INDUCED SOLID STATE POLYMERIZATION OF 3,3-BIS(CHLOROMETHYL) OXETANE

Mitsuo Okada, Masanobu Nishii, Kanae Hayashi, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 159–177 refs Presented at the 14th Ann. Meeting of the Polymer Soc., Tokyo, May 1965 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Radiation-induced in-source and post polymerization of 3,3-bis (chloromethyl) oxetane (BCMO) in solid state were carried out at various conditions. In the case of in-source polymerization, saturation of polymer yield was observed at the lower temperature polymerization and in presence of air. At 0°C, no saturation phenomenon was observed both in gradually and rapidly cooled samples, but the latter had a very small initial rate of polymerization. In post polymerization, the polymer yield always saturates at very low conversion and is largely dependent on the crystalline state of monomer. From the kinetical consideration adopted for the solid state polymerization of trioxane, the rate constants for the propagation and termination and the mean lifetimes of the active center of polymerization were calculated at several temperatures. Results of polymerization under the pulse irradiation of electron beams, ultraviolet sensitized post polymerization, and G_i value estimation by the addition of iodine are included. Author

N67-22238# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

ESR STUDY ON THE MECHANISM OF RADIATION INDUCED SOLID STATE POST POLYMERIZATION OF 3, 3-BIS(CHLOROMETHYL) OXETANE

Kozo Tsuji, Kanae Hayashi, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 178–186 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The electron spin resonance spectrum of 3,3-bis(chloromethyl) oxetane, which was radiated and observed at a temperature of −196°C, was studied. The main spectrum, a triplet with a coupling constant of 24 gauss, was superposed by a doublet spectrum of 15 gauss. As the temperature was increased, the triplet disappeared at about −70°C and the doublet spectrum remained until +15°C. A mechanism is proposed to explain the radiation-induced solid state post polymerization. Differences in G values for the formation of doublet spectrum radicals (3) and for the initiation of polymerization (0.8) are attributed to the existence of radicals that are not involved in the polymerization. M.W.R.

N67-22239# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

ESR STUDIES OF IRRADIATED PYRIDINE AND ITS DERIVATIVES

Kozo Tsuji, Hiroshi Yoshida, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 187–198 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Solid phase pyridine, pyridine-d_5 and some derivatives were irradiated with electron beams at −196°C. The ESR spectra were measured from −196°C to the melting point. A triplet spectrum (splitting 30 gauss) with a quartet substructure (splitting

4.3 gauss), observed at −196°C, was assigned to a cation radical. When the temperature was raised the triplet spectrum disappeared, and the eight line spectrum (splitting 12 gauss) observed at −90°C which was assigned to another radical. After this radical disappeared, a singlet spectrum was observed at −65°C that disappeared at about −50°C. It was assigned to the pyridyl radical. The radicals produced in the irradiated pyridine-d_5 were the same as in the irradiated pyridine. When picolines and vinylpyridines were irradiated, free radicals were observed that may be produced by addition of a hydrogen atom to the pyridine ring or by abstraction of a hydrogen atom from the methyl group or pyridine ring. Author

N67-22240# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

ESR STUDIES OF IRRADIATED POLY 3,3-BIS (CHLOROMETHYL) OXETANE

Kozo Tsuji, Hiroshi Yoshida, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 199–204 refs (See N67-22223 10-06) CFSTI: HC $3.00/MF $0.65

Poly 3,3-bis(chloromethyl) oxetane was irradiated with electron beams at −196°C, and the ESR spectra were measured. A triplet spectrum (coupling constant 21 gauss), observed at −196°C, was superposed by a doublet spectrum (coupling constant 18 gauss). As the temperature was raised, the triplet spectrum disappeared at about −60°C. This triplet spectrum was assigned to the free radical R-CH_2 produced by abstraction of a chlorine atom from a side group or by main chain scission. The doublet spectrum was assigned to free radicals produced by abstraction of a hydrogen atom from the main chain. In the case of ultraviolet irradiation at −196°C, a triplet spectrum (coupling constant 20 gauss) was observed that was also assigned to the free radical produced by abstraction of chlorine atom from side group or by main chain scission. When the irradiated sample was treated at −87°C for the 132 min, the triplet spectrum disappeared and an asymmetric singlet spectrum resulted. Author

N67-22241# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

ESR STUDY ON THE SOLID STATE POLYMERIZATION OF *N*-VINYL CARBAZOLE INITIATED BY ELECTRON ACCEPTORS

Kozo Tsuki, Koichi Takakura, Masanobu Nishii, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 205–206 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

A mechanism is given for the polymerization of N-vinyl carbazole (N-VCZ) that is initiated by electron acceptors. While II and III type radicals are observed in the mechanism by ESR methods, the colors of the complexes with carbazole and poly N-VCZ were lighter than those with N-VCZ. Only the N-VCZ-SO_2 system exhibits an asymmetric doublet spectrum, supposedly caused by the unpaired electron localized on SO_2. M.W.R.

N67-22242# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

POLYMERIZATION OF TRIOXANE AND TETRAOXANE IN THE PRESENCE OF GASEOUS ELECTRON ACCEPTOR

Masanobu Nishii, Kozo Tsuji, Koichi Takakura, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 207–215 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Solid phase polymerization is studied for trioxane, tetraoxane, and N-vinyl carbazole (VCZ) in the presence of gaseous electron acceptors such as chlorine and sulfur dioxide. At temperatures greater than 25°C, trioxane polymerization proceeded similarly to radiation-induced polymerization; and polymer yield was reduced in the solution. A copolymer produced by treating a eutectic mixture of trioxane and VCZ with chlorine or sulfur dioxide gas was recognized as a block copolymer of polyoxymethylene and polyvinyl carbazole. Electron spin resonance measurements were made to determine the initiation mechanism, and the resulting spectra were identified. The initiating species may be considered a cation radical in which an odd electron is delocalized over the conjugated double bond system of the carbazole ring. M.W.R.

N67-22243# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

POLYMERIZATION OF CYCLIC ETHERS IN THE PRESENCE OF MALEIC ANHYDRIDE. IV: FURTHER INVESTIGATION OF THE POLYMERIZATION MECHANISM

Koichi Takakura and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 216–224 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The polymerization of cyclic ethers such as trioxane or 3,3-bis(chloromethyl) oxetane initiated by both radiation and benzoyl peroxide (BPO) in the presence of maleic anhydride (MAH) were investigated. When a small amount of the γ-rays or UV irradiated equimolar solution of a cyclic ether and MAH was added to isobutyl vinyl ether (IBVE), a rapid polymerization took place and the resulting polymer was confirmed to be a homopolymer of IBVE. The heated soution of dioxane, MAH, and a small amount of BPO could initiate the polymerization of IBVE in the same manner. Electrical conductivity of 1:1 mixture of MAH and dioxane was increased about ten times after UV-irradiation, and some cationic species were actually formed in the system by irradiation or the decomposition of added BPO. The mechanism of the formation of cationic species responsible for the initiation may be explained by the formation of a free radical of an ether by abstraction of a hydrogen atom attached to the carbon adjacent to oxygen atom, followed by an electron transfer from the resulting radical to MAH, an electron acceptor. This yields the cationic species of the ether, and the anion-radical of MAH, respectively, both resonance-stabilized. Cationic polymerization of these cyclic ethers was markedly accelerated in the presence of MAH as a solvent, suggesting that MAH participates not only in the initiation, but also in the propagation of the polymerization. Author

N67-22244# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

CATIONIC POLYMERIZATION OF ISOBUTYL VINYL ETHER AND N-VINYLCARBAZOLE INITIATED BY THE SPECIES DERIVED FROM ETHEREAL MALEIC ANHYDRIDE

Koichi Takakura, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 225–233 refs Presented at the 18th Ann. Meeting of the Chem. Soc. of Japan, Osaka, Apr. 1965 Submitted for publication (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Polymerizations of isobutyl vinyl ether (IVBE) and N-vinyl carbazole (VCZ) were carried out by the use of the cationic species derived from ethereal maleic anhydride (MAH) as a catalyst. The catalyst systems were prepared by dissolving MAH in a number of cyclic and chain ethers that were either irradiated in air by γ-rays or UV light, or heated *in vacuo* in the presence of a small amount of benzoyl peroxide. Homopolymerization of IBVE in bulk and VCZ in solutions readily occurred in air at 30°C by the addition of these catalysts. The initiating activities of the active species formed were examined for polymerization of IBVE and VCZ. The higher the concentration of MAH in an ethereal solution, the better initiating activity was observed. However, irradiated MAH alone could hardly initiate such polymerization. Polymerization of VCZ in toluene by the use of an irradiated dioxane-MAH system as a catalyst was investigated. Author

N67-22245# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

THE POLYMERIZATION OF N-VINYLCARBAZOLE BY MALEIC ANHYDRIDE AS AN ELECTRON ACCEPTOR

Koichi Takakura, Koichiro Hayashi, Seizo Okamura, and Eiko Kawa *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 234–243 refs Presented at the 18th Ann. Meeting of the Chem. Soc. of Japan., Osaka, Apr. 1965 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Polymerization of N-vinyl carbazole (VCZ) occurred by the addition of an excess of maleic anhydride (MAH). When the mixture of VCZ and a large amount of MAH was allowed to stand at 70°C, or in toluene solution at 50°C, high yields of a homopolymer of VCZ were obtained within 1 hr. The polymerizing system developed an intense yellow color, which is attributed to the formation of the charge transfer complex between VCZ and MAH. Polymerization, which took place in the presence of air and of a radical scavenger such as DPPH, was markedly enhanced in a polar solvent such as acetone. The MAH acts as both an initiator and a favorable solvent for the polymerization. An ESR study of the mixture of VCZ and MAH showed a singlet spectrum, which may be due to a cation radical of VCZ. A cation radical with a localized carbonium ion formation may initiate the polymerization by a cationic mechanism, in which an anion radical of MAH acts a counter ion for a propagating chain end. Author

N67-22246# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

SYNTHESIS AND POLYMERIZATION OF METHYLTRIOXANES

Akira Shimizu, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 244–248 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The preparation and polymerization of methyltrioxane (II) and dimethyltrioxane (III) were studied. These trioxane derivatives were synthesized by cotrimerization of formaldehyde and acetaldehyde catalysed by mineral acid; and the structures were confirmed by elemental analysis, molecular weight measurement, and infrared and NMR spectrum measurement. The polymerization of these two monomers was tried by some typical cationic catalysts and γ-ray irradiation. Dimethyltrioxane did not polymerize, but the polymerization of methyltrioxane observed with boron trifluoride etherate led to the solid polymer. Author

N67-22247# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

IONIZATION AND DISSOCIATION OF ALIPHATIC KETONES

Motoyoshi Hatada and Kozo Hirota *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 249–276 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Ionization potentials and positive charge distributions of group bonds of ten aliphatic ketones were calculated by an extended group-bond orbital method. The calculated ionization potentials of these ketones agreed with observed values, and the calculated positive charge distributions showed good correlation with the bond-scission probabilities obtained from mass spectra. Author

N67-22248# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

IONIZATION AND DISSOCIATION OF ALIPHATIC ETHERS UNDER ELECTRON IMPACT

Jun'chi Takezaki, Kozo Hirota, and Motoyoshi Hatada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 277–281 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The method of group bond orbital on mass spectrum was applied to calculate the ionization potentials and bond-scission probabilities of aliphatic ethers. The calculated ionization potentials agreed well with the measured ones. The calculated positive charge distributions showed fair correspondencies to the bond-scission probabilities obtained from mass spectra, except in the case of methyl-n-propyl ether. Author

N67-22249# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

IONS PRODUCED FROM ALIPHATIC ETHERS BY ELECTRON IMPACT

Kozo Hirota, Jun'chi Takezaki, and Motoyoshi Hatada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 282–287 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

High resolution mass spectrometry indicated that some of the spectral peaks of aliphatic ethers are composed of two or three individual peaks that differ slightly from one another in their masses. All of the multiplets observed indicated the presence of more than one ion of nearly the same mass. For example, the doublets at m/e=29 possessed both the CHO^+ and the $C_2H_5^+$ ions. Spectra are included for a number of the ethers, and details of the mass spectra are tabulated. M.W.R.

N67-22250# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

THE GASEOUS PRODUCTS FROM THE RADIOLYSIS OF OXYGEN-CONTAINING COMPOUNDS

Toshiro Isoya, Motoyoshi Hatada, and Kozo Hirota *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 288–294 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Radiolysis of triacetin, glycerin, and acetonyl acetone was studied to study the effect of the number of structural units within a molecule on radiation-induced reactions, or the G values of the resulting products. A straight line was found for each compound when the gaseous product yields were plotted as a function of the energy absorbed; and the G values for the products show linear relationships with the reciprocal of the number of structural units. M.W.R.

N67-22251# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

THE GASEOUS PRODUCTS FROM THE RADIOLYSIS OF ALPHATIC HYDROCARBONS

Toshiro Isoya, Motoyoshi Hatada, and Kozo Hirota *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 295–302 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The G values of hydrogen from $-(-CH_2)-$ have a linear relation to 1/n in the region of $n<5$, and are independent of n in the region of $n>5$. This finding may be explained by an intramolecular dissipation of absorbed energy, and may be useful to predict the approximate G value of related compounds. Author

N67-22252# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

EXPERIMENTAL STUDIES OF PULSE RADIOLYSIS: α-METHYLSTYRENE

Mesiaki Katayama, Hatsuo Yamasaki, Yasutomo Ozawa, Motoyoshi Hatada, and Kozo Hirota *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 303–313 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Pulse radiolytic experiments, such as performance of linear accelerator, performance of the flash lamp for photographic

recording, and arrangement of instruments, are given. Spectrograms are included of transient absorption in α-methylstyrene. Author

N67-22253# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
SYNTHESIS OF 3-HEPTANONE-2, 2, 4, 4-d_4
Motoyoshi Hatada, Mitsuo Okada, and Kozo Hirota *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 314–317 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

To study the ionization and dissociation resulting from the electron bombardment of aliphatic ketones, 3-heptanone-2,2,4,4-d_4 was synthesized by repeated exchange of 3-heptanone with deuterium oxide. Isotopic and chemical properties of the deuterium-containing products were analyzed by gas chromatography and by mass, infrared, and nuclear magnetic resonance spectrometry. The ketone product exhibits heavy hydrogen substitutions to both sides of the carbonyl group, and the spectra indicate that the four methylenic hydrogens in the original compound are replaced by deuterium. M.W.R.

N67-22254# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
ESR STUDY OF IRRADIATED ACETONE AT LOW TEMPERATURE
Isamu Nitta, Shun'ichi Ohnishi, Shun'ichi Sugimoto, and Keiji Kuwata *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 318–331 refs Presented at the 18th Ann. Meeting of the Chem. Soc. of Japan, 1965 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The ESR spectrum of γ-irradiated acetone at −196°C is composed of a broad asymmetric singlet with g=2.002 an and additional hf's of a free radical. The brownish-black color and the ESR signal of the singlet disappear gradually by illumination with visible light. The effect of illumination with monochromatic light of different wavelength on the ESR signal was investigated. The changes in spectrum due to the addition of methyl ethyl ketone and carbon tetrachloride were determined. These results indicate that in acetone electron trapping occurs, and the electron causes the color and the ESR of the broad asymmetric singlet. Author

N67-22255# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
ESR STUDY OF IRRADIATED SOLID CYCLOALKENES
Isamu Nitta, Tadayuki Ohmae, Shun'ichi Ohnishi, Keiji Kuwata, and Hiroshi Sakurai *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 332–336 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

The parent cycloalkyl radicals formed during the electron-irradiation of solid cycloalkenes exhibit a motional narrowing or structural deformation on heating. Such a temperature-dependent motional narrowing is shown for cyclopentene, and the narrow lines (triplet-quintet) are attributed to the cyclopentyl radical that comes from a loss of allyl-hydrogen in cyclopentene. A nine line spectrum measured at −196°C after irradiation of cycloheptene exhibited an additional doublet structure at −145°C; and the nine lines are attributed to the cycloheptenyl radical, which seems to be locked in a rigid nonplanar form at temperatures below −145°C. The hyperfine coupling constants are tabulated for the cycloalkenyl radicals, and electron spin resonance spectra are included for cyclooctene, cycloheptene, and cyclopentene. M.W.R.

N67-22256# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
STEREOISOMERIC RADICALS IN IRRADIATED CIS AND TRANS CYCLOHEXANE-1,2-DIOL
Isamu Nitta, Tadayuki Ohmae, Shun'ichi Ohmishi, Keiji Kuwata, and Hiroshi Sakurai *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 337–342 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Electron spin resonance spectroscopy is used on both irradiated cis and trans cyclohexane-1,2-diol to confirm the existence of two axial beta protons with large hyperfine coupling constants. The G values for the two diol-1 radicals and cyclohexanol-1 radical are nearly constant up to a total dose of 4.5 1.5×10^{6}r. Remarkable changes occur in the spectra of both diol-1 radicals when the electron-irradiated samples are warmed; and the original spectra do not reappear when the temperature is lowered to −196°C. M.W.R.

N67-22309# Los Alamos Scientific Lab., N. Mex.
KINETICS OF THE ANION EXCHANGE OF URANIUM (VI) ON DOWEX IX4 FROM NITRIC ACID SOLUTIONS
D. B. James 20 Dec. 1966 14 p refs
(Contract W-7405-ENG-36)
(LA-3541) CFSTI: HC $3.00/MF $0.65

The kinetics of the sorption of uranium(VI) from nitric acid solutions on Dowex 1X4 anion-exchange resin were studied. The system is controlled by diffusion within the resin phase and described by a constant-diffusion-coefficient theory. Diffusion coefficients for 5, 7, and 8.3*M* nitric acid at 24°C are 7.4×10^{-8}, 5.2×10^{-8}, and 4.0×10^{-8} cm^2/sec, respectively, and for 7*M* nitric acid at 40 and 60°C are 1.2×10^{-7} and 3.3×10^{-7} cm^2/sec, respectively. The diffusional activation energy is 13 kcal/mole. Author (NSA)

N67-22314# Union Carbide Nuclear Co., Oak Ridge, Tenn.
DIRECT ESTIMATION OF FREE FLUORIDE ION IN TWENTY PERCENT NITRIC ACID ETCHING SOLUTIONS
W. C. Dietrich 8 Dec. 1966 25 p refs
(Contract W-7405-ENG-26)
(Y-1560) CFSTI: HC $3.00/MF $0.65

Free fluoride ion was estimated directly in twenty percent nitric acid solutions containing fluoride, aluminum, beryllium, niobium, zirconium, and uranium ions by correlating the dissolution times of zirconium foils or siliceous films to reactive free fluoride ions. Author (NSA)

N67-22315# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
CURIUM PROCESS DEVELOPMENT. III-2: IDENTIFICATION OF SOLVENT DEGRADATION PRODUCTS
David L. West and Richard Narvaez Nov. 1966 18 p refs
(Contract AT(07-2)-1)
(DP-1016) CFSTI: HC $3.00/MF $0.65

The principal products of solvent degradation during two of the solvent extraction steps of the curium process were identified as primary and secondary amines (from the tertiary amine extractant) and aromatic alcohols and ketones (from the diethylbenzene diluent). In batch tests, the principal causes of solvent degradation were radiolysis in the extraction banks of the nitrate-to-chloride conversion steps and chemical oxidation during solvent washing in the lanthanide removal step. Hydrazine was found to inhibit solvent degradation in the conversion step. Author (NSA)

N67-22324# Oak Ridge National Lab., Tenn.
EXAMINATION OF HYDROUS URANIUM DIOXIDE PRECIPITATES AND SOLS BY ELECTRON MICROSCOPY, ELECTRON DIFFRACTION, AND SPECTROPHOTOMETRY
C. J. Hardy Aug. 1966 22 p refs
(Contract W-7405-ENG-26)
(ORNL-3963) CFSTI: HC $3.00/MF $0.65

Electron micrographs and selected-area electron diffraction patterns were obtained for hydrous UO_2 precipitated from uranous nitrate and uranous nitrate-formate solutions and aged for periods of a few minutes to a few days at 25°C, and heated for several hours at 60° to form sols. Thus the particles of UO_2 can be characterized as they are converted from a precipitate into a sol, which in turn is converted into UO_2 microspheres for use in fuel elements. Studies showed that the initial precipitates (hydrous UO_2) consisted of irregularly shaped aggregates of particles about 15 to 25 Å in diameter. The initially diffuse lines in the electron diffraction patterns became sharper with increased aging at 25°C. Sols prepared by heating the filtered and washed precipitates at 60°C consisted of cubic crystals with sides 10 to 20 Å long. The presence of 0.4 mole of formate per mole of U in the sols gave more uniform dispersion on the electron microscope grids, but did not appreciably affect the size or the lattice spacing of the primary crystallites. The turbidities or apparent absorption spectra of the diluted sols were measured from 8000 to 3000 Å. The optical density varied inversely with the 1.2 to 1.4th power of the wavelength from 8000 to 4000 Å and with the fourth power of the wavelength at less than 4000 Å. The maximum diameter of the scattering particles, calculated from the turbidity at 4000 Å, was about 800 Å, which agrees with the size of aggregates observed on the electron micrographs. A model is proposed for the physical and chemical constitution of the formate-containing sol particles in which formate ions bridge pairs of U atoms on the surface of primary cubic crystallites of 10.9 Å edge length; these crystallites are then considered to form aggregates up to 800 Å in diameter. Author (NSA)

N67-22328# California Univ., Livermore. Lawrence Radiation Lab.

GRAPHICAL REPRESENTATIONS OF SELECTED FUNCTIONS OF INTERPLANAR SPACINGS FOR 5184 INORGANIC X-RAY POWDER DIFFRACTION PATTERNS

Monte C. Nichols 4 Aug. 1966 11 p refs

(UCRL-50115) CFSTI: HC $3.00/MF $0.65

Graphical representations of the distributions of strong d-spacing for 5184 inorganic mineral and nonmineral X-ray powder diffraction patterns are given. The bimodal character exhibited by some of the distributions is discussed. The usefulness and limitations of the Hanawalt scheme for identification using the ASTM file are discussed in the light of the distributions presented. The method of the inverse match (comparison of standard patterns with an unknown pattern, rather than unknown pattern with standard patterns) and its application to computer search techniques are discussed. Author (NSA)

N67-22340# Sandia Corp., Albuquerque, N. Mex.

FLASH PHOTOLYSIS AND TIME RESOLVED MASS SPECTROMETRY: REACTION OF EXCITED IODINE ($^2P_{1/2}$) ATOMS IN THE DECOMPOSITION OF METHYL IODIDE

Richard T. Meyer Dec. 1966 30 p refs

(Contract AT(29-1)-789)

(SC-RR-66-669) CFSTI: HC $3.00/MF $0.65

The flash photolysis of methyl iodide has been studied by time resolved mass spectrometry. Mixtures of CH_3I vapor with Ar, O_2, Kr, and N_2 at total pressures of 5 to 12 torr have been photolyzed with flash durations as short as 18 μsec. The ultraviolet light flux was approximately 3×10^{18} quanta/cm^2. A modified Bendix TOF mass spectrometer provided 1.4 μsec sampling intervals every 50 μsec. Overall decomposition of CH_3I was 20 to 75 percent, with the larger decompositions occurring in the absence of the added gases. I_2, CH_4, C_2H_6, C_2H_4, and some C_2H_2 are formed as final products. All systems show I_2 formation by two processes, one fast and one slow. The fast process occurs within a time interval of 75 μsec after the flash peak and accounts for approximately 50 percent of the total I_2 production. This rapid formation of I_2 cannot be explained in terms of a thermolecular recombination of atomic iodine nor in terms of an evaluated temperature reaction between ground state iodine atoms and methyl iodide. It was concluded that excited, metastable $I(^2P_{1/2})$ atoms are produced in the primary decomposition. These excited atoms have sufficient energy (21.7 kcal/mole) to undergo the following reaction: $I(^2P_{1/2})+CH_3I\rightarrow CH_3+I_2+3$ kcal. This bimolecular reaction accounts for the rapid formation of molecular iodine. Author (NSA)

N67-22381# Los Alamos Scientific Lab., N. Mex.

STRUCTURE IN LIQUID Au–Cd AND Ce–Cd SOLUTIONS, VAPOR PRESSURE AND ELECTRICAL RESISTIVITY LIQUID COMPOUNDS, TWO-LIQUID REGIONS, PREMONITORY PHENOMENA, AND FREEZING

Guy R. B. Elliott, Claude C. Herrick, Joe Fred Lemons, and Paul C. Nordine 12 Oct. 1966 40 p refs

(Contract W-7405-ENG-36)

(LA-3526) CFSTI: HC $3.00/MF $0.65

The electrical resistivity of liquid Cd and Au–Cd solutions and the vapor pressures of Au–Cd and Ce–Cd solutions were measured. The existence of extensive solid-like structure in these strongly bonded liquids is indicated by these measurements. Liquid compounds and premonitory phenomena are demonstrated. Melting and freezing are discussed in light of the premonitory phenomena. Author (NSA)

N67-22382# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

ANNOTATED BIBLIOGRAPHY OF THE CHEMISTRY AND PHYSICS OF AMERICIUM

H. W. Miller 5 Dec. 1966 70 p refs

(Contract AT(29-1)-1106)

(RFP-770) CFSTI: HC $3.00/MF $0.65

Chemistry areas covered include the (1) history, (2) vapor pressure, (3) thermodynamics, (4) metals and alloys, (5) crystal structure, (6) magnetic susceptibility, (7) electronic configuration, (8) absorption, emission, and infrared spectroscopy, (9) separation and purification, (10) instrumental analysis, (11) higher valence states, (12) kinetics and disproportionation, (13) complexes, (14) compounds, (15) electrochemistry, (16) source preparation, (17) processing, and (18) production of americium. Physics areas covered include the (1) nuclear spectroscopy, (2) decay, (3) specific activity of the half-life, (4) nuclear spin-magnetic moments, (5) nuclear cross sections, (6) fission, (7) source preparations, and (8) isotope production the transuranium element. Author and subject indexes for the bibliographic literature are also included. L.S.

N67-22383# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

NEUTRON POISONED ION EXCHANGE EQUIPMENT

D. S. Irwin 15 Nov. 1966 16 p refs

(Contract AT(29-1)-1106)

(RFP-782) CFSTI: HC $3.00/MF $0.65

A neutron-poisoned ion exchange column was built for use in the purification of plutonium nitrate solutions. The column was poisoned by stainless steel grids containing ^{10}B. The column performed satisfactorily but was found to be uneconomical. An improved design utilizing boron carbide tubes instead of grids was developed. This design would overcome most of the difficulties of the grid column but would offer little economic advantage over non-poisoned ion exchange equipment. Author (NSA)

N67-22384# Los Alamos Scientific Lab., N. Mex.

THE DISTILLATION SEPARATION AND SPECTROPHOTOMETRIC MEASUREMENT OF MICROGRAM QUANTITIES OF SILICON

T. K. Marshall and G. R. Waterbury 1 Dec. 1966 24 p refs
(Contract W-7405-ENG-36)
(LA-3559) CFSTI: HC $3.00/MF $0.65

Microgram quantities of silicon are measured spectrophotometrically as the silicomolybdic acid complex following separation from plutonium and other elements by distillation as silicon tetrafluoride. The distillation is done in a platinum still to avoid contamination of the sample. The silicon tetrafluoride is collected in a dilute solution of boric and molybdic acid to form silicomolybdic acid which is reduced with a 1-amino-2-naphthol-4-sulfonic acid–sodium bisulfite solution. The absorbance of the reduced complex is measured at a wavelength of 825 mμ. Based upon 14 determinations each of 2.08, 5.2, 10.4, 20.8, and 31.2 μg of silicon, the relative standard deviation of the method was found to be 16, 10.1, 2.8, 2.1, and 2.1%, respectively. The molar absorptivity of 19,400 calculated from these data shows that 2 ppM (2 μg of silicon in a 1.0-g plutonium sample) can be determined reliably. The method tolerates at least 1 g of plutonium and 100 mg of several other elements. Most serious interference is caused by aluminum, iron, and zirconium.
Author (NSA)

N67-22386# Los Alamos Scientific Lab., N. Mex.
THE DETERMINATION OF FREE (UNCOMBINED) CARBON IN PLUTONIUM CARBIDES
T. K. Marshall and G. R. Waterbury 2 Dec. 1966 21 p refs
(Contract W-7405-ENG-36)
(LA-3603) CFSTI: HC $3.00/MF $0.65

Free (uncombined) carbon in plutonium carbide is determined gravimetrically following dissolution of the sample in hydrochloric acid and ignition of the free carbon to carbon dioxide at 1000°C in oxygen. The plutonium carbide is placed on an asbestos mat held by a perforated porcelain disc near the bottom of a 55-mm length of fused silica tubing and dissolved in hydrochloric acid. The tars formed by this dissolution are washed from the mat with acetone. The filter tube is dried under heat lamps and placed in a tube furnace for oxidation of the carbon to carbon dioxide which is absorbed in an Ascarite-filled tube and weighed. Relative standard deviations for determinations of free carbon in four plutonium carbide samples were in the range of 6 to 11%. These percentages include differences in results caused by possible heterogeneity of the samples in addition to deviations inherent in the method of measurement. It was concluded that the relative standard deviation of the method was no greater than 10%.
Author (NSA)

N67-22457# Los Alamos Scientific Lab., N. Mex.
DISTRIBUTION OF AMERICIUM BETWEEN LIQUID PLUTONIUM AND A FUSED SALT. EVIDENCE FOR DIVALENT AMERICIUM
L. J. Mullins, A. J. Beaumont, and J. A. Leary 1 Dec. 1966 26 p refs
(Contract W-7405-ENG-36)
(LA-3562) CFSTI: HC $3.00/MF $0.65

The distribution of Am between liquid Pu metal and a fused salt of NaCl–KCl containing $PuCl_3$ has been studied at 698, 730, and 775°C over a $PuCl_3$ mole fraction range of 8×10^{-3} to 2×10^{-2}. The distribution data are consistent with the following equation: $Am\ (l) + (^2/_3)PuCl_3\ (l) = (^2/_3)Pu\ (l) + AmCl_3\ (l)$. From the temperature dependence of the equilibrium constant, a value of −3.5 kcal was obtained for ΔH° for the above reaction.
Author (NSA)

N67-22474# Bureau of Mines, Amarillo, Tex.
EQUATION OF STATE FOR HELIUM-NITROGEN MIXTURES FROM 133.15° TO 748.15°K WITH PRESSURES TO 33 ATMOSPHERES
Robert E. Wood, W. J. Boone, Jr., J. D. Marshall, and F. W. Baer 1967 186 p refs
(BM-RI-6896) CFSTI: HC $3.00/MF $0.65

The compressibility factors, Z, of He, Ni, an He–Ni mixtures in the three-dimensional space of temperature, pressure, and gas composition have been related to the Leiden form of the virial equation of state. The dependency of virial coefficients through the fifth on temperature and gas composition has been established for the temperature range 133.15° to 748.15°K. Compressibility factors, Z, have been computed from the equation of state and tabulated as functions of gas composition, pressure, and temperature. Tabular values of Z are presented for 30.00 through 100.00 percent He for temperatures from 240° through 700° R for pressures from 14.696 through 3,050 psia and for temperatures from 720° through 1,300°R for pressures from 14.696 through 1,500 psia. Tabular values of Z are presented at increments of 5.00 percent He and 20°R, and, for pressures greater than 50 psia, at increments of 50 psi.
Author

N67-22492# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France)
CHEMICAL PROBLEMS INHERENT TO USE OF PROPELLANTS ON THE SECOND STAGE OF LAUNCH VEHICLE EUROPA [PROBLEMES CHIMIQUES POSES PAR L'EMPLOI DES ERGOLS DU DEUXIEME ETAGE DE L'ENGIN EUROPA I]
M. Lemaitre *In* ELDO Tech. Rev., Vol. I, No. 3 1966 p 155–172 refs In FRENCH; ENGLISH summary (See N67-22491 11-06) CFSTI: HC $3.00/MF $0.65

After a short account of the synthesis and of the principal properties of the propellants, nitrogen peroxide and unsymmetrical dimethyl hydrazine, a number of chemical problems concerning specification and use (safety precautions and emergency measures) are described.
Author (ESRO)

N67-22559# Aerospace Corp., El Segundo, Calif.
COMMENTS ON MOLECULAR MOTION IN INFRARED AND RAMAN SPECTRA
Jerome M. Dowling Dec. 1966 11 p refs
(Contract AF 04(695)-669)
(TR-669(9260-01)-5; SSD-TR-67-6; AD-646349) CFSTI: HC $3.00/MF $0.65

Interferograms, the information which is directly obtained from two-beam interferometers and is related to the Fourier cosine transform of the spectrum, are interpreted in terms of molecular motions as described by Gordon. Portions of the pure rotational interferogram of carbon monoxide are shown and discussed.
Author (TAB)

N67-22564# Nuclear Research Associates, Inc., Long Island City, N. Y.
THEORETICAL STUDIES OF COMPLEXED TRANSITION METAL THERMOPHOTOTROPIC SYSTEMS Final Report, 1 Apr. 1965–31 Mar. 1966
Jerome Goodman, Stanley Grand, and Sarah Mook Aug. 1966 37 p refs
(Contract NOw-65-0443-c)
(NRA-854; AD-646539) CFSTI: HC $3.00/MF $0.65

Studies were undertaken on heat- and light-induced darkening of films and solutions containing high concentrations of copper bromide. Previous work had shown that the reaction was basically thermal, with darkening occurring as a result of equilibrium shifts to give dark copper complexes, and of reversible solvent loss to effectively increase the copper salt concentration. This new work demonstrated that the darkening due to changes in equilibrium constants could be increased by varying the solvent or bromide concentration, so that solvent loss with its disadvantages might eventually be eliminated. In addition, initial feasibility was shown

for the replacement of the polymer matrix with inorganics, and for the electrical actuation of the films at high frequency without contact electrodes. Author (TAB)

N67-22637# Purdue Univ., Lafayette, Ind.
COMPLEX HYDRIDES Final Report, 1 Jul. 1954–30 Jun. 1966
Herbert C. Brown 21 Dec. 1966 8 p refs
(Contracts DA-33-008-ORD-2002; DA-31-124-ARO(D)-117; Grant DA-ARO-D-31-124-G 106)
(AROD-1287-18; AD-645581) CFSTI: HC $3.00/MF $0.65

Brief summaries of the following investigations are given: (1) Stereochemistry of reduction of cyclic and bicycle ketones by alkoxy-substituted lithium aluminum hydrides; (2) Hydrogenation of nitro compounds and the quantitative determination of unsaturation in organic compounds via hydrogenation; (3) General reducing characteristics of metal hydrides, lithium aluminum hydride, lithium tri-t-butoxyaluminohydride, lithium trimethoxyaluminohydride, aluminum hydride, and disiamylborane; (4) Directive effects in the hydroboration of representative allyl derivatives; (5) Unsymmetrical olefins and coupling via organoboranes; (6) Applicability of dialkylborane reduction as a probe to determine the less hindered side of a carbonyl group; (7) A new aldehyde synthesis from phenolic esters with lithium tri-t-butoxyaluminohydride; (8) Reduction of epoxides with various metal hydrides. Author (TAB)

N67-22668# Frankford Arsenal, Philadelphia, Pa. Quality Assurance Directorate.
DESENSITIZATION OF ZIRCONIUM POWDER USED IN PRIMERS, PHASE IV Final Report
George Norwitz and John J. Jackiewicz Dec. 1966 33 p refs
(T60-24-4; AD-645274) CFSTI: HC $3.00/MF $0.65

The mechanics of the desensitization process for zirconium powder used in primers wherein zirconium powder is treated with 1% hydrofluoric acid is considered. On the basis of experimental work and logical deduction it is concluded that the process consists of the dissolution of the oxide surface and the formation of a layer of zirconium hydride containing some fluoride. A method was developed for the determination of the fluoride colorimetrically by the zirconium-alizarin colorimetric method after prior dissolution of the coating by digestion with hot 10% sodium hydroxide solution. The only significant difference between treated and untreated samples was the hydrogen and fluoride contents. Treated zirconium had a hydrogen content that averaged 0.035% higher than untreated powders. Treated zirconium contained about 0.14% fluoride. Various other aspects of the coating were considered. The desensitization process is useful to Ordnance particularly if the zirconium powder in question is overly sensitive (that is, if it does not pass the electrostatic energy test). The effect of impurities on the sensitivity of zirconium powders is discussed. Author (TAB)

N67-22693# Ohio State Univ. Research Foundation, Columbus.
TRANSITION METAL COMPLEXES WITH TWO NEW SERIES OF TETRADENTATE LIGANDS Final Report, 1 Oct. 1963–30 Sep. 1966
Devon W. Meek 14 Nov. 1966 11 p refs
(Grant DA-ARO(D)-31-124-G500)
(AROD-4486-5; AD-646013) CFSTI: HC $3.00/MF $0.65

An investigation was undertaken of the coordinating properties of flexible tetradentate phosphorus, arsenic, and nitrogen ligands of the type D(CH2CH2CH2D')3, (where D does not = D'). A series of nickel (II) complexes with the five coordinate (Ni(ligand)X)(+) cations was isolated and studied extensively. A number of Pd(II) and Co(II) complexes were also examined. A second series of studies involved the nature of bonding in boron-transition metal complexes having groups of the type B(OCH2CH2NR2). Also, the syntheis of a number of tetradentate compounds with boron-carbon bonds was undertaken (e.g., B(Ph-AsO2)3). TAB

N67-22699# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
DETERMINATION OF POLYOLS IN ALKYD AND POLYESTER RESINS BY GAS LIQUID CHROMATOGRAPHY
George G. Esposito Nov. 1966 15 p refs
(CCL-214; AD-646227) CFSTI: HC $3.00/MF $0.65

Polyols are one of the major components in alkyd and polyester resins and the physical characteristics of these resins are greatly influenced by the type of polyol present. The objective of this investigation was to develop a quantitative analytical procedure for dihydric alcohols which would be suitable for quality control. The procedure described in this report employs gas chromatography for the analysis of polyols liberated from resins by refluxing with butylamine. Qualitative and quantitative analysis for diols is accomplished by standardization with known polyol solutions. Author (TAB)

N67-22739# Pittsburgh Univ., Pa. Metallurgical and Materials Engineering Dept.
EFFECT OF TEMPERATURE ON THE SYNTHESIS OF CERIUM CHALCO GENIDES Final Report
S. H. Klinvex and J. A. Berger 30 Nov. 1966 90 p refs
(Contract NObs-77068)
(AD-646011) CFSTI: HC $3.00/MF $0.65

The purpose of the investigation was to develop an isothermal study for the cerium-sulfur compositions synthesized over the temperature range of 600C to 1300C in 25 degree increments. Cerium sulfide compounds were synthesized under a carbon disulfide atmosphere from ceria (CeO2) in a carbon combustion tube furnace. Wet chemistry results are documented for 35 cerium sulfide compounds prepared under isothermal conditions over the temperature range of 600C to 1300C. From the wet chemistry data, a partial binary diagram is proposed for the cerium-sulfur system. The amount of the oxide converted to sulfide for the 600C to 1300C temperature region is illustrated graphically. A limited amount of density data is presented in graphical form. X-ray diffraction data for the cerium sulfide compounds are tabulated. Cerium dissolves 25 per cent sulfur at 1300C and 27 per cent at 1115C, forming a Th3P4 type body-centered cubic structure. Complex X-ray diffraction spectra were obtained for the cerium sulfide compounds prepared below 1100C. From 950C to 1100C, two cubic phases were indexed as follows: a body-centered cubic Ce3S4 type structure with an a sub o value of 8.65 A being the predominant phase, the second phase is simple cubic with an a sub o value of 8.85 A. TAB

N67-22852*# Aerojet-General Corp., Azusa, Calif.
ANALYTICAL DEVELOPMENT WORK ON BIS-(PHENOXY-PHENYL) ETHERS, MIX 4P3E
R. R. Jay 27 Oct. 1964 17 p refs
(NASA-CR-72196; TM-390-64-4-249) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Analytical procedures were developed for the characterization and quality control of Mix-4P3E. A high temperature (300°C) gas chromatographic method employing a silicone oil partitioning liquid was developed for resolution of the six isomers of Mix-4P3E and for determination of volatile contaminants. Characterization of impurities was performed by infrared and nuclear magnetic resonance spectroscopy, and by chemical testing. Specific tests were also developed for total halogens and phenolic contaminants. Author

N67-22869*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNTHESIS OF HIGHER ORDER HYDROCARBONS ON HOT TUNGSTEN FILAMENTS

H. Shapiro and B. N. Paxson Washington, NASA, Apr. 1967 11 p refs
(NASA-TN-D-3906) CFSTI: HC $3.00/MF $0.65 CSCL 07C

This study uses a quadrupole mass spectrometer of sensitivity 10^{-15} torr (N_2 equivalent) to show the synthesis of acetylene, ethane, propylene and propane from methane on a hot tungsten filament. The study investigates the relationship between the partial pressures of these hydrocarbons and the filament temperature. The constancy of the product composition for a given temperature at two partial pressures of methane is also demonstrated. Acetylene, the most abundant of the synthesized hydrocarbons, is found to have a partial pressure only about one decade less than the parent methane. The measurement of total pressure in the ultra high vacuum regions by hot filament gauges may be erroneous due to this kind of synthesis. Author

N67-22875 Stanford Research Inst., Menlo Park, Calif.
STUDY OF BONDING BETWEEN GLASS AND PLASTIC IN GLASS-REINFORCED PLASTIC–EXTENDED WORK Quarterly Progress Report, Oct. 1–Dec. 31, 1966
David L. Chamberlain, Jr. 23 Mar. 1967 8 p refs
(Contract NASr-49(14))
(NASA-CR-83420; Rept.-11; QPR-9) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The effects of surface modification upon a realistic composite material (such as a filament wound NOL ring or a woven glass cloth laminate) are evaluated. Results from fluorination reactions with glass and silica, and alkylation reactions with halogenated Cab–O–Sil samples are given. The optimum characteristics for surface modifying groups, and improved methods for obtaining them are studied. Applications of these modification methods to reinforcement materials other than glass and silica are considered. Results of carbon and infrared analyses, and dilatometric experiments are presented. L.S.

N67-22880*# Aerojet-General Corp., Azusa, Calif.
EVALUATION OF METHODS TO REMOVE DECOMPOSED MIX-4P3E FROM 9Cr-Mo STEEL
F. H. Cassidy 2 Aug. 1965 10 p refs
(NASA-CR-72223; TM-4923-65-310) CFSTI: HC $3.00/MF $0.65 CSCL 07B

The evaluation of selected candidate procedures for removal of thermally decomposed mix-4P3E is reported. Oxidation of the residue by 1300°F air exposure, followed by pickling, successfully removed surface adherent residue. The procedure consisted of twice performing the multi-step cycle: (1) air exposure at 1300°F for 1/2 hour; (2) three-step clean with Turco Products, Inc., fluids Turco 4931, then Turco 4338C and finally Turco 4931. A yellowish surface discoloration of the specimen resulted from cleaning. Further evaluation is required to determine if this surface condition represents an unacceptable mercury non-wetting condition. Author

N67-22910 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
PROTON SPIN-LATTICE RELAXATION IN LIQUID METHANE [RELAKSACJA SPINOWO-SIECIOWA PROTONOW W CIEKLYM METANIE]
Andrzej Jasinski, Maria Bozek, and Jacek W. Hennel Oct. 1966 16 p refs Submitted for publication
(NP-500/PL)

The proton spin-lattice relaxation time T_1 in liquid CH_4 under the pressure of saturated vapour was measured within the range of temperature from melting point to critical point and in the gas up to 218°K. It was found that T_1 first increases and then decreases when the temperature is raised. This behaviour is explained on the basis of the Hubbard's theory of spin-rotational relaxation. Author

N67-22940# Kernforschungsanlage, Jualich (West Germany). Zentralbibliothek.
NEON: ITS PHYSICAL AND PHYSICAL-CHEMICAL PROPERTIES—A BIBLIOGRAPHY [NEON PHYSIKALISCHE UND PHYSIKALISCH-CHEMISCHE EIGENSCHAFTEN—EINE LITERATURZUSAMMENSTELLUNG]
H. Huertgen Aug. 1965 43 p refs In GERMAN
(JUL-BIBL-10) CFSTI: HC $3.00/MF $0.65

A 462-title bibliography of articles published between 1920 and 1964 is presented. The following sources were used: *Chemical Abstracts, Chemisches Zentralblatt, Engineering Index, Nuclear Science Abstracts, Physics Abstracts,* and *Physikalische Berichte.* Groupings are by the following categoreis: thermodynamics; transport properties; change effect of neon with solid bodies and accomodation coefficients; solubility of neon in liquids; solid neon; general information and physical properties; and production and use of neon. Transl. by K.W.

N67-22981# Atomic Weapons Research Establishment, Aldermaston (England).
ANALYTICAL CHEMISTRY MANUALS. A BIBLIOGRAPHY AND INDEX TO THEIR CONTENTS
W. A. Dowden Oct. 1966 115 p refs
(AWRE/LIB/BIB/15) HMSO: 15s 0d

A bibliography of manuals on analytical methods developed and used by laboratories, mainly for process control, is presented. Included are indexes to the substances determined, materials analyzed, and the miscellaneous procedures that were utilized. C.T.C.

N67-22997# Eidgenossische Technische Hochschule, Zurich (Switzerland).
SOLVOLYTIC REACTIONS IN THE STEROID FIELD
Juan–Julio Bonet Sugranes (Ph.D. Thesis) 1965 68 p refs *Its* Dissertation No. 3702
CFSTI: HC $3.00/MF $0.65

The solvolysis of 19-mesyloxy derivatives in the androstane series produces additional cyclizations of the steroidal skeleton in the presence of electron-donating groups in suitable positions. Thus, an isolated 4,5-double bond was well as the enolate anions of unsaturated conjugated 3-ketones act as nucleophiles to yield cyclopropane or cyclobutane derivatives, depending on the relative positions of the reaction centers. The experimental evidence favors an S_Ni2i rather than an S_Ni substitution mechanism. The solvolysis of a 3-ethylenedioxy-4-mesyloxy-5-hydroxy androstane yields quantitatively a 10(5→4)-abeo compound. The reaction is formulated as a pinacol rearrangement, based on a sort of "push-pull" mechanism. Author

N67-23004# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE SPECTROFLUORIMETRIC DETERMINATION OF SUB-MICROGRAM CONCENTRATIONS OF URANIUM IN AQUEOUS SOLUTION
T. Bruce and R. W. Ashley Nov. 1966 10 p refs
(AECL-2647; CRDC-1249) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

The fluorescence of U^{VI} in phosphate solution has been re-examined with the objective to determine sub-microgram concentrations of uranium. The effect of phosphoric acid and phosphate ion concentration on the relationship between fluorescence intensity and uranium concentration has been determined. At optimum conditions, 0.3 M H_3PO_4 and 1.74M $NH_4H_2PO_4$, 0.05 μg U/ml can be measured with an error of ±0.01 μg uranium. Author

N67-23012 Polish Academy of Sciences, Warsaw.
PULSE METHODS IN CHEMISTRY [METODY IMPULSOWE W CHEMII]

Zbigniew P. Zagorski 1966 19 p refs In POLISH; ENGLISH summary
(Rept.-758/SVII/C) CFSTI: HC$3.00

Pulse methods in chemistry are presented and discussed in the order of increased range of chemical changes in the system. Such line begins with relaxation methods (e.g. temperature jump method) in which only the chemical equilibrium is shifted suddenly. The survey ends with pulse radiolysis methods, where in very short periods of time intermediates are formed, reacting afterwards into stable compounds. Author

N67-23013 Polish Academy of Sciences, Warsaw.
URANIUM (VI) EXTRACTION FROM SULPHURIC ACID SOLUTIONS WITH TRI-N-OCTYPHOSPHINE OXIDE SOLUTIONS IN BENZENE [EKSTRAKCJA URANU(VI) Z ROZTWOROW KWASU SIARKOWEGO ROZTWORAMI TLENKU TROJ-N-OKTYLOFOSFINY W BENZENIE]
Czeslaw Deptula 1966 12 p refs In POLISH; ENGLISH summary
(Rept.-754/XIII/C) CFSTI: HC$3.00

The uranium (VI) extraction from sulphuric acid solutions with tri-n-octylphosphine oxide solutions in benzene has been investigated. On the basis of the dependence of log E' –log[TOPO] and the results of the chemical analysis of the organic phases the composition of the extracted compound has been determined– UO_2SO_4·2TOPO. Author

N67-23014# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ACIDITY OF CYCLOHEXANECARBOXYLIC ACIDS, CYCLOHEXYLAMINES AND RELATED COMPOUNDS
Conrado Pascual Rigau (Ph.D. Thesis) 1965 59 p refs
(Prom.-3763) CFSTI: HC$3.00/MF$0.65

This work deals with the application of physico-chemical methods in the elucidation of the structure of organic compounds. Evaluated were acidity measurements, infrared spectroscopy, and thermoelectric molecular weight determinations to cyclohexanecarboxylic acids, cyclohexylamines and related compounds. The purpose is to correlate the experimental data with the structure and stereochemistry of such compounds. Author

N67-23026# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
ISOTOPE EXCHANGE BETWEEN HYDROGEN AND LIQUID AMMONIA IN THE PRESENCE OF A HETEROGENEOUS CATALYST [ISOTOPENAUSTAUSCH ZWISCHEN WASSERSTOFF UND FLUESSIGEM AMMONIAK IN GEGENWART HETEROGENER KATALYSATOREN]
Jan. 1962 94 p refs In GERMAN
(JUL-31-PC) CFSTI: HC$3.00/MF$0.65

Isotope exchange between hydrogen and liquid ammonia was studied for various catalysts, at temperatures between –60°C and +25°C, and at pressures up to 150 at. Results were compared to control reactions between hydrogen and gaseous ammonia at partial hydrogen pressures of 50 Torr to 1.5 at, and for ammonia pressures of 25 Torr until saturation vapor pressure. It was found that: (1) potassium amide was the most effective catalyst in liquid hydrogen exchange reactions with liquid ammonia; (2) metals from the 8th group of the periodic system acted as catalysts for the H/D exchange between hydrogen and liquid ammonia below –60°C; (3) the isotope exchange between hydrogen and water at 20°C had nearly the same velocity as H/D exchange for hydrogen and liquid ammonia; (4) the speed of the isotope exchange increased proportional to the catalyst volume when a platin/activated carbon catalyst was employed; and (5) the exchange velocity for the system $(NH_3)_l$/HD at catalysis with potassium amide increased proportionally to the hydrogen pressure. Transl. by G.G.

N67-23031# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkestoffe.
A PHYSICO-CHEMICAL ANALYTIC METHOD FOR THE TESTING OF REACTOR MATERIALS AND NUCLEAR FUEL [PHYSIKALISCH-CHEMISCHE ANALYSENMETHODEN ZUR UNTERSUCHUNG VON REAKTORMATERIALIEN UND KERNBRENNSTOFFEN]
H. Nickel Jan. 1965 144 p refs In GERMAN
(JUL-216-RW) CFSTI: HC$3.00/MF$0.65

Neutron activation, hot oxygen extraction, spectral emission, X-ray fluorescence and diffraction, and electron microscopic methods are evaluated for their application in reactor technology. It was found that the $O^{16}(n,p)N^{16}$ nuclear reaction was suitable for quantitative analysis of oxygen in metal powders and steel; the hot extraction and oxygen determination method was usable to determine oxygen impurities in uranium carbide fuels; and electron microscopy can determine the homogeneous element distribution and compatibility between fuel element and coating material. Spectral emission methods were often disturbed by electrode reactions; and X-ray fluorescence measurements of element concentration required accurate analytical data on material composition. Transl. by G.G.

N67-23036 Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H. Seibersdorf (Austria). Isotopenanwendung.
DETERMINATION OF BORON CONTENTS OF LOW CONTENT BORON STEEL ALLOYS BY MEASURING THE FLUX DEPRESSION OF THERMAL NEUTRONS [BESTIMMUNG DES BORGEHALTES VON NIEDERBORIERTEN STAEHLEN DURCH MESSUNG DER FLUSSDEPRESSION THERMISCHER NEUTRONEN]
E. Frevert 1966 14 p refs In GERMAN Submitted for publication
(SGAE-1B/1A-11/1966) CFSTI: $3.00

This nondestructive analysis on boron content in steel specimens employs thermal neutron flux depression by isotopic B^{10} to obtain boron concentration values when the percentage of other steel components is known. The method has a sensitivity down to 0.001% boron content and makes it possible to supervise boron distribution in steels. Author

N67-23073# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COLLECTION AND DETERMINATION OF TRACE AMOUNTS OF URANIUM USING CELLULOSE PHOSPHATE ION EXCHANGE PAPER
T. Bruce and R. W. Ashley Nov. 1966 8 p refs
(AECL-2648) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.20

Cellulose phosphate ion exchange paper has been investigated as a means of collecting trace amounts of uranium prior to its determination. Spectrofluorimetric determination of uranium directly on the paper is not feasible for quantitative analysis, but can be used for qualitative analysis. X-ray fluorescence measurements on the paper can be used for quantitative measurements down to 10 μg U with a precision of ±4 μg. Author

N67-23077# United Kingdom Atomic Energy Authority, Windscale (England). Technical Dept.
ANALYTICAL METHOD FOR THE DETERMINATION OF TRI-ISO-BUTYL PHOSPHATE IN TRI-NORMAL-BUTYL PHOSPHATE (GAS CHROMATOGRAPHY)
1966 8 p
(PG-755(W)) HMSO: 1s 3d

The sample is mixed with n-tridecane and part of the mixture injected into an Apiezon L chromatographic column maintained at 200°C. After the components have been eluted from the column the ratio of the height of the n-tridecane peak to the height of the tri-i-butyl phosphate peak is used to determine the concentration of tri-i-butyl phosphate in the sample. Author

N67-23092# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
SLUDGE CONCENTRATION WITH A CENTRIFUGAL SEPARATOR
R. Lopes Cardozo, J. Vaccarezza, and S. Vanuzzi Dec. 1966 18 p refs
(EUR-3175.e) CFSTI: HC$3.00/MF$0.65

The use of a centrifugal separator for the volume reduction of sludges emanating from the decontamination of radioactive waste water by coprecipitation is described. Results obtained during 35 days of operation are tabulated. Among the conclusions are: (1) The concentrate is of a consistency that excludes dust hazards. (2) The sludge removal from the flocculator is continuous and the sludge level is easy to regulate. (3) The treatment of the sludge is almost instantaneous, and the quantity present in the processing units is small, thereby reducing the radiation hazards to a high degree. (4) The operation costs of the 500-fold volume reduction are low. N.E.N.

N67-23101# General Applied Science Labs., Inc., Westbury, N. Y.
ANALYSIS AND DESCRIPTION OF AN IBM 7090/94 PROGRAM TO COMPUTE EQUILIBRIUM CONDITIONS FOR GASEOUS CHEMISTRY SYSTEMS
Herbert H. Hopf 14 Dec. 1966 63 p refs
(Contract DA-49-083-OSA-3135; ARPA Order 396)
(TR-643; AD-644898) CFSTI: HC$3.00/MF$0.65

The program is based on the minimization of the Gibbs free energy of the system; the resulting non-linear equations are solved by a modified Newton-Raphson iteration scheme. The three options presently available for the two intensive variables necessary for the calculation of the equilibrium composition are pressure-temperature, pressure-enthalpy and pressure-entropy, although other options for any two intensive variables may be readily added. A program generator that produces the source program cards in FORTRAN IV of the equilibrium program for a specific chemistry system was also written. In the process of generating the source program, the generator extracts from a library magnetic tape the necessary curve fits for the species enthalpy and entropy as functions of temperature for the specified chemistry system. This resulting source program may be utilized as a subroutine to serve the needs of each particular application. Author (TAB)

N67-23107# Picatinny Arsenal, Dover, N. J. Pyrotechnics Lab.
EVALUATION OF NEW PHOTOFLASH FORMULATIONS
David J. Edelman, Seymour M. Kaye, and Bossie Jackson, Jr. Jan. 1967 36 p refs
(PA-TR-3382; AD-645763) CFSTI: HC$3.00/MF$0.65

Photoflash systems containing hafnium and potassium perchlorate in stoichiometric (72/28), fuel rich (77/23, 82/18), and calculated maximum efficiency (87/13) proportions generally exhibit greater luminous efficiency on a volume basis (candleseconds per cubic centimeter) than the conventional 60/40 potassium perchlorate/aluminum and Type 3, Class A photoflash formulations under either ambient conditions or reduced pressure conditions simulating an 80,000-foot altitude. With increased hafnium content, greater integral light and volumetric efficiency values are obtained under either ambient or high altitude conditions. Under reduced pressure conditions, the stoichiometric hafnium/potassium perchlorate system and a ternary blend of hafnium/potassium perchlorate/barium nitrate (72/14/14) gave superior peak light intensity values when compared with the above conventional formulations as well as the optimum high altitude flash system of 90/20 calcium/potassium perchlorate. Author (TAB)

N67-23132# Minnesota Univ., Minneapolis. Dept. of Chemistry.
SHOCK WAVES IN CHEMICAL KINETICS. FURTHER STUDIES IN THE DISSOCIATION OF FLUORINE
Daniel J. Seery and Doyle Britton Dec. 1966 19 p refs
(Contract DA-31-124-ARO-(D)-161)
(AROD-2062-11; AD-646057) CSFTI: HC$3.00/MF$0.65

The rate of dissociation of molecular fluorine was determined in the temperature range 1300-1700K by observing spectrophotometrically the disappearance of F2 molecules behind shock waves in a shock tube. Experiments were made in 5% F2-95% Ar, 5% F2-20% Kr-75% Ar, 10% F2-20% Kr-70% Ar, 5% F2-20% Xe-75% Ar, and 10% F2-20% Xe-70% Ar mixtures. The results in mixtures with only F2 and Ar present, combined with earlier work, give log kD(1/mole liter/sec) = 9.49 - 5970/T (corresponding to an apparent activation energy of 27.3 plus or minus 2.5 kcal/mole) for the rate of the reaction M + F2 to M + 2F. The experiments with added Kr showed no anomalies, and indicated that Kr is at most only slightly more efficient than Ar in this reaction. The experiments with added Xe showed anomalous results. No quantitative conclusions could be drawn, but it appears highly likely that XeF is an important intermediate in the reaction system, and that XeF2 is present in appreciable amounts in the final equilibrium mixtures. Author (TAB)

N67-23138# Marine Engineering Lab., Annapolis, Md.
THE DYNAMIC BEHAVIOR OF THE OXYGEN-PEROXIDE SYSTEM ON PLATINUM
R. J. Bowen and H. B. Urbach Jan. 1967 21 p refs
(MEL-TM-8/67; AD-645592) CFSTI: HC$3.00/MF$0.65

The cathodic behavior of oxygen-peroxide systems in an alkaline environment (pH = 14) was determined by the reduction of oxygen to peroxide when the concentration of peroxide is relatively low and by the reduction of peroxide to water when its concentration is relatively large. At low peroxide concentration, Tafel slopes of ca. -2RT/3 F were observed. Increase of oxygen pressure translates these Tafel curves without rotation toward increased currents in direct proportion to the pressure. In contrast, peroxide concentration changes do not influence the Tafel slopes in the low concentration range. Tafel slopes at high peroxide concentrations, ca. 200 mv, are, however, translated, without rotation in direct proportion to the concentration of peroxide. Author (TAB)

N67-23166# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Labs.
STUDY OF ROTATIONAL ISOMERISM IN FLUOROACETYL FLUORIDE BY MICROWAVE SPECTROSCOPY
Ellen Saegebarth and E. Bright Wilson, Jr. [1967] 48 p refs
(Contract Nonr-1866(14); Grant NSF GP-6413)
(AD-645803) CFSTI: HC$3.00/MF$0.65

Fluoroacetyl fluoride was found to have two distinct sets of pure rotational transitions in the microwave region 8 to 36 kMc/sec, which was identified as arising from two rotamers, one with the two fluorine atoms trans to one another and the other in which they are in the cis positions. These spectra were analysed and moments of inertia obtained. The Stark effect gives the dipole moment components: trans Mu-a = 0.456 plus or minus 0.010 D, Mu-b = 2.63 plus or minus 0.05 D, Mu = 2.67 plus or minus 0.05 D; cis Mu-a = 1.18 plus or minus 0.03 D, Mu-b = 1.68 plus or minus 0.04 D, Mu = 2.05 plus or minus 0.06 D; Mu-c = 0 for both forms. Several sets of satellite lines were observed and assigned to torsionally excited trans molecules, to a skeletal bending mode, and to a combination of these. Relative intensities then gave trans frequencies near 127/cm for the torsion and 265/cm for the bending. Intensities also gave an energy difference, cis-trans, of 910 plus or minus 100 cal/mole. The available data do not completely define the torsional potential function but suggest that the three-fold component may be in the range 1000-1300 cal/mole as in acetyl derivatives. The two-fold component must be dominant to produce the cis instead of gauche minimum. Author (TAB)

N67-23206# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

LABORATORY DEVELOPMENT OF THE GRIND-LEACH PROCESS FOR THE H.T.G.C.R. FUEL CYCLE. PART 2. DISSOLUTION OF BERYLLIA IN NITRIC ACID SOLUTIONS

M. S. Farrell, S. R. Isaacs, and M. E. Shying Jun. 1966 28 p refs

(AAEC-E-154) CFSTI: HC$3.00/MF$0.65

The development of the grind-leach process for the processing of beryllia-based fuels requires a knowledge of the dissolution of beryllia in nitric acid. A kinetic study using powdered specimens proved suitable for the investigation of this system. The parameters studied include particle size, agitation, temperature, acid concentration, the effect of the addition of fluoride and aluminum, and the effect of neutron irradiation of the beryllia. The dissolution of beryllia in nitric acid is controlled by a chemical reaction at the surface of the solid and has an apparent activation energy of 18 kcal/mole. Author (NSA)

N67-23209# Los Alamos Scientific Lab., N. Mex.

INTERACTION OF PENTACHLORIDE OF NIOBIUM WITH OXYGEN

A. N. Ketov and I. M. Kolesov [1966] 8 p refs Transl. into ENGLISH from Izv. Vyssh. Uchebn. Zaved., Tsvet. Met. (Dzaudzhikau), v. 9, no. 3, 1966 p 77–80

(LA-TR-66-70) Available from JCL

The reaction between $NbCl_5$ and oxygen were observed at temperatures above the melting point of the chloride. Up to 600°C the process took place with the formation, basically, of $NbOCl_3$, and above 600°C, of $NbOCl_3$ and Nb_2O_5. The increase in the content of oxygen in gas phase did not change the nature of the reaction, but the degree of transformation in this case increased. The presence of chlorine in gas phase reduced the average velocity of the reaction. Author (NSA)

N67-23210# Tennessee Univ., Knoxville.

ELECTROCHEMICAL STUDIES IN MOLTEN FLUORIDES AND OTHER HALIDES Progress Report, Apr. 1, 1966–Mar. 31, 1967

Glev Mamantov 5 Jan. 1967 5 p refs

(Contract AT(40-1)-3518)

(ORO-3518-1) CFSTI: HC$3.00/MF$0.65

EMF and electrode kinetics measurements on the Ni/Ni(II) couple in molten LiF–NaF–KF (46.5–11.5–42 mole %) and LiF–BeF_2–ZrF_4 (65.6–29.4–5.0 mole %) have been performed. The results obtained resulted in a practical reference electrode for molten fluoride compositions. Voltammetric studies of negative oxidation states of bismuth in molten halides will be resumed after the modification of the dry box. A multipurpose electro-analytical instrument for molten salt studies is under construction. Author (NSA)

N67-23220# Nuclear Materials and Equipment Corp., Apollo, Pa.

GROWTH OF SINGLE CRYSTALS OF PLUTONIUM Progress Report, Jul. 1–Sep. 30, 1966

Dec. 1966 24 p refs

(Contract AT(30-1)-3428)

(NUMEC-3428-26) CFSTI: HC$3.00/MF$0.65

Large grains of alpha-Pu(≈1 mm×0.9 mm) were grown using a variety of experimental conditions associated with a parametric study of the effects of varying cooling rate, pressure, and temperature of high-pressure release prior to cooling. All of the high-pressure runs in this series were done at 350°C with 4 hours holding times. The isothermal transformation of beta-Pu for 800 hours at 106.5±0.5°C resulted in a highly sub-grained alpha-Pu microstructure having an average grain size of 0.4 mm. Author (NSA)

N67-23225# Atomic Power Development Associates, Inc., Detroit, Mich.

AEC SPONSORED ACTIVITIES Quarterly Technical Progress Report, 15 Jun.–15 Sep. 1966

15 Sep. 1966 86 p refs

(Contract AT(11-1)-865)

(APDA-195) CFSTI: HC$3.00/MF$0.65

An investigation of Na–water reactions from small leaks is being conducted to determine machaniams of reactor tube wastage from this cause. During the report period data and information were gathered on target-tube temperatures and surface effects from Na–water reactions. In other work, testing was initiated in a steel reaction vessel to determine target metal surface temperature as function of target–leak spacing and water leak rate. Test results are presented from Na technology loop operation on response of rhometers and O_2 meters to NaO injections in the loop and cold traps. Development work on Na scanner includes demonstration of an A-scan mode for scanning narrow-beam transducers. Compilation of Fermi experience was continued. Assistance was given PNL on design of the Fast Flux Test Facility. NSA

N67-23238# Glasgow Univ. (Scotland). Dept. of Chemistry.

STUDIES IN RING EXPANSION Final Scientific Report, 1 Jan. 1963–31 Dec. 1966

George L. Buchanan 31 Dec. 1966 11 p refs

(Grant AF-EOAR-63-36)

(AFOSR-67-0036; AD-645488) CFSTI: HC$3.00/MF$0.65

New synthetic routes to seven-membered rings were developed from bicyclo (3,2,1) octane derivatives by reactions which sever the one carbon bridge. Cycloheptanones, cycloheptenes and a tropolone were obtained using this procedure. The cycloheptene synthesis was used to build the skeleton of the alkaloid colchicine and the tropolone synthesis provides a new and unambiguous route to beta-substituted tropolones. The conformation of a cycloheptene was shown to be the chair form. Attempts to construct large rings by a variant of this procedure were unsuccessful. Author (TAB)

N67-23264* Southern Univ., Baton Rouge, La. Dept. of Chemistry.

A STUDY OF THE REACTION OF COPPER (II) ION WITH 4-METHYL-3-PENTEN-2-ONE

Ivory V. Nelson and James Dillon [1967] 9 p refs

(Grant NGR-19-005-001)

(NASA-CR-83537) CFSTI: HC$3.00/MF$0.65 CSCL 07C

A spectrophotometric study of the reaction demonstrated that the complex ion, Cu(4-methyl-3-penten-2-one)$^{+}$, and the precipitate involving two moles of 4-methyl-3-penten-2-one and one mole of copper (II) ion were formed. The rate of the formation of the complex ion was found to be first order in copper (II) ion, and the reaction to form both the complex ion and the precipitate proceeds at a faster rate in solvents of lower dielectric constant. Author

N67-23381# Coating and Chemical Lab., Aberdeen Proving Ground, Md.

VOLUMETRIC DETERMINATION OF FREE ISOCYANATE IN URETHANE COATING RESINS Final Report

George G. Esposito Nov. 1966 12 p refs

(CCL-219; AD-646224) CFSTI: HC$3.00/MF$0.65

A procedure is described for the determination of free isocyanate in urethane coating materials. Increasingly large quantities of urethane resins are being consumed and since the presence of relatively small amounts of free toluene diisocyanate (TDI) is considered a health hazard, it was considered essential to devise a procedure for its determination. Free TDI is separated from prepolymers and resins by vacuum distillation and the isolated isocyanate is determined volumetrically. TAB

N67-23372# Stanford Research Inst., Menlo Park, Calif.
GASEOUS PRECISION ETCHING OF MOLYBDENUM
Ruth C. Preist Nov. 1966 38 p refs
(Contract Nonr-2887(00))
(AD-645201) CFSTI: HC $3.00/MF $0.65

Reactions which lead to the solution or volatilization of molybdenum and which are suitable for high-precision etching of patterns in thin films of molybdenum are not well known. In a search for a process for etching cavities in films 1mu thick it has been found that the formation and simultaneous removal of molybdenum trioxide can be achieved by exposure of heated molybdenum films to a mixture of oxygen and hydrogen chloride gases. Etch rates of 1000 to 10,000 A/min have been obtained with specimen temperatures of 400 to 600C and with gas pressures between 0.1 and 1 torr. An etch factor of about 2 has been typical, and the final etched surface has been as smooth if not smoother than the original surface. Aluminum oxide of about 0.1 mu thickness has been used as a resist. It is hoped that an electron-exposed organic resist can eventually be adapted for use with this process. Discussion and speculation on the mechanism of formation of the oxide and its removal have been included, as well as discussion of some of the factors which are important in predicting the optimum conditions for etching. A residue of a very thin, adherent layer of MoO2 on partially etched molybdenum surfaces has been a problem, and means for removing this film are discussed. The process appears to have promise for etching with dimensional control accurate to better than 0.1mu in films 1mu thick. Greater precision may be possible in films thinner than 1mu. TAB

N67-23374# Pennsylvania State Univ., University Park. Dept. of Chemistry.
CHEMICAL PROPERTIES OF LABILE SPECIES Final Report, 1961–1966
P. S. Skell Jan. 1967 7 p refs
(Grants AF-AFOSR-62-52; AF-AFOSR-503-64)
(AFOSR-67-0044; AD-645534) CFSTI: HC $3.00/MF $0.65

The primary objective of the program was the study, at room temperature or below, of the chemical properties of species stable at high temperatures. The most interesting class of substances which falls in this category are the atomic species, which for the main part have not been studied as reactive species. The major effort was expended in the study of vaporized carbon. The chemistry of monatomic C was studied in three states and triatomic C in two states. The properties of these species are now known with as much detail as any of the reactive free radicals or carbenes, and it is possible to define with some confidence the mechanistic pathways followed in the reactions of these species with the substrates. TAB

N67-23401*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECT OF CERTAIN ADDITIVES ON THE THERMAL DECOMPOSITION OF AMMONIUM PERCHLORATE
A. A. Shidlovskiy, L. F. Shmagin, and V. V. Bulanova Redstone Arsenal, Ala., Redstone Sci. Inform. Center, 25 Jan. 1967 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), no. 4, 1965 p 533–538 Jointly supported by Army Missile Command
(NASA-TM-X-59483; RSIC-640) CFSTI: HC $3.00/MF $0.65 CSCL 07B

A study was made of the thermal decomposition of perchlorate of ammonium (PA) at 214° to 470°C by the gravimetric method in an air atmosphere. The following values of the energies of activation of the decomposition have been determined: orthorhombic form, E=40 kcal/mole; cubic form, E=24 to 28 kcal/mole; and residue from low-temperature reaction E=36 to 39 kcal/mole. A study was made of the influence of oxides, chlorides, carbonates, and oxalates of a number of metals on the thermal decomposition of PA. It was shown that the compounds of manganese and cobalt lead to complete decomposition of the PA at a temperature below 240°C. The compounds of iron, nickel, and chromium lead to complete decomposition of PA at 270° to 280°C. At the same temperature, the maximum rate of decomposition of PA with additives of the compounds of Cu, Mn, Co, as well as ZnO is greater than the maximum decomposition rate of the pure PA; the maximum decomposition rate of mixtures of PA with compounds, of iron, nickel (II), chromium, as well as V_2O_5 is less than for pure PA. The activity of additives of the same element decreases in the following order: carbonate (oxalate), oxide, and chloride. Author

N67-23442# Georgetown Univ., Washington, D. C. Coll. Observatory.
ANALYSIS OF THE FIRST SPECTRUM OF TITANIUM FROM 20000 Å TO 9000 Å
Harvey W. Banks, William R. Bozman, and Christopher M. Wilson [1966] 177 p refs *Its* Monograph No. 20
(Grant NSF GP-4682) CFSTI: HC $3.00/MF $0.65

The spectrum of titanium is analyzed to determine new levels from lines hitherto not seen or recorded and to improve on past studies of the neutral spectrum increasing the overall accuracy. A brief review of the history of studies on titanium is given, and the astrophysical importance of spectral analysis is stressed. Three tables give the observed lines of the titanium spectrum from 2107 to 3072 Å, from 3000 to 6000 Å, and from 6000 to 9000 Å. Data are tabulated for: the wavelength in air of each observed line, the intensity of each spectral line, lines attributed to titanium II, wavenumber in Kaysers (waves per centimeter) calculated with the aid of Edlen's formula, classification, the J-value, and the numerical difference between the observed and the computed wavelength. S.P.

N67-23453# Applied Research Labs., Glendale, Calif.
DYNAMIC ANALYSIS WITH X-RAY FLUORESCENCE INSTRUMENTATION
W. G. Shequen and A. H. Smallbone 1966 8 p refs *Its* Vol. 19, No. 3 and 4
CFSTI: HC $3.00/MF $0.65

Dynamic analysis of inprocess materials is viewed in terms of the advantages of X-ray fluorescence instrumentation which has justified further development of the technique and related hardware for online control analysis. The development has resulted in automatic high-speed continuous analysis of materials in dry or wet form. When integrated with proper data handling equipment this instrumentation can make automatic correction to cope with both instrument and process variables. C.L.W.

N67-23463# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. (Calif. Univ., Berkeley) 31 Dec. 1966 21 p refs
(Rept.-21) Available from Natl. Bur. of Std., Washington, D. C.

A bibliography containing references to literature on spectroscopy of interest to high temperature chemistry, and reactions between gases and condensed phases is presented. R.N.A.

N67-23471# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE DIFFUSION OF GOLD AND SILVER IN TIN SINGLE CRYSTALS

Brian F. Dyson Jan. 1966 16 p refs
(Contract ARPA SD-88)
(ARPA-22)

The diffusivities D, of gold and silver in high purity tin have been measured along the "c" and "a" directions in the temperature range 135–225°C. Results are characterized by a very large anisotropy of diffusion compared with that found for the self diffusion of tin. Furthermore, these solutes diffuse orders of magnitude faster than the self diffusion of tin and also they diffuse fastest along the "c" direction, whereas tin diffuses fastest along the "a" direction. This unusual behavior is interpreted as evidence that silver and gold dissolve interstitially in tin and diffuse by an interstitial mechanism. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-21989# Main Geophysical Observatory, Leningrad (USSR).
PRINCIPLES OF DATA CODING AND PROCESSING AS APPLIED TO THE DESIGN OF AUTOMATIC TELEMETERING METEOROLOGICAL STATIONS (ATMS)
S. M. Persin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 28–38 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The methods suggested for increasing the accuracy of coding units to be used in the automatic telemetering meteorological stations (ATMS) are examined. The technique permits greater simplicity in design, and can be used for both contact and noncontact types of coding units, and for such analog input parameters as voltage, electric resistance, or frequency. Based on the automatic determination of the total error of the coding device, with the reverse sign in the final result introduced as a correction, these self-correcting coding units are equipped with automatic tracking for elimination of errors. A schematic of the design is shown, along with block diagrams of the self-corrected coding unit with stepped approximation using the pulse–time coding principle, and of the self-corrected system based on the feedback principle with capacitive storage of pulse charge. Operational details are given. M.G.J.

N67-21990# Main Geophysical Observatory, Leningrad (USSR).
PROBLEM OF LINKING ATMS TO THE GENERAL TELEGRAPH CIRCUIT
A. M. Bogomolov and V. P. Petrov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 39–44 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The classification of telemetering systems as a function of data reduction processes and the final use of data is depicted, and the problems involved in selecting the proper type of telemetering system are analyzed. It is pointed out that the automatic telemetering meteorological stations (ATMS) should be equipped with several devices to carry out unit data processing, i.e., to convert the measurement results into signals easily transmissible through the telegraph. This is achieved by having correction tables; correction data may be introduced by standard punch cards. A schematic is included on the basic equipment of the station, which consists of a digital compensation voltmeter (DCV) to ensure voltage measurement in a decimal three-digit code. The operating cycle of the DCV is described in detail. A circuit diagram and layout of the unit for automation of retransmission of meteorological telegrams are also included. M.G.J.

N67-22005# Central Aerological Observatory (USSR).
INCREASING THE RECEIVER SENSITIVITY OF AN AEROLOGICAL RADAR SET
A. G. Gorelik, V. V. Kostarev, I. G. Potemkin, and A. A. Chernikov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observation 1966 p 149–157 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

A special storage circuit was designed to improve the signal-to-noise ratio at the output of a conventional radar receiver operating on the centimeter wave band. The storage device compared the average values of two series of short-time samples of the averaged and modulated input signal. Samples were taken twice during each cycle of radar operation, and the first sample was delayed for a certain time interval. The delay time of the signal sample over its width was then used for averaging the noise and the useful signal. This storage device can detect a weak radar echo, determine the coordinates of its source, and receive data on the magnitude of the reflected signal. G.G.

N67-22007# Central Aerological Observatory (USSR).
EQUIPMENT FOR THE STUDY OF STATISTICAL CHARACTERISTICS OF RADAR ECHO
A. G. Gorelik *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 166–171 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Statistical methods are used to characterize a reflected pulsed radar signal and relate the fluctuation factors to magnitude and distribution velocities of scattering particles in clouds. A special selector-analyzer unit for determining reflected radar-echo signals was developed that consists of a signal-channel unit, a control-channel unit, a heterodyne spectrum analyzer, and a device for recording the average signal level. Changes in signal delay time permit the selection of any reflecting target intercepted by the radar beam. The analyzer unit is designed as a heterodyne analyzing circuit with consecutive analysis for both manual and automatic frequency control. G.G.

N67-22209# Israel Program for Scientific Translations, Ltd., Jerusalem.
COMMUNICATION FACILITIES FOR 500 kV TRANSMISSION LINES
K. E. Mikhailov *In its* 500 kV Long-Distance Electric Transmission 1966 p 476–501 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The services that communication systems provide for the operation and maintenance of 500 kV transmission lines are described. These services include telephone connections between dispatcher points in power systems, between the administrative and engineering staff, and between organizations responsible for maintenance and repair; communication channels for remote control, telemetery, signaling, and regulation; signal transmission for blocking operation or disconnecting equipment during line damage or equipment failure; and private exchanges at substations. Also discussed are the protection of communication lines from the influence of transmission lines and noise interference effects on communication channels. R.N.A.

N67-22221* Radio Corp. of America, Moorestown, N. J.
APOLLO SHIPS INSTRUMENTATION RADAR PROGRAM Final Report, Aug. 1964–Oct. 1965
Apr. 1966 118 p refs
(Contract NAS5-9720)
(NASA-CR-83517) CFSTI: $3.00 CSCL 09F

Design, development, and acceptance testing are summarized for the Apollo Spacecraft Radar Set, Model AN/FPS-16(V), which makes maximum use of components developed for earlier radars of this type. Equipment characteristics and system performance parameters are described; as are system signal flow, system

operational modes, and subsystem designs. Testing is reported for the transmitter, modulator, antenna, receiver, angle servo, range tracker, and console and mode switch. Boresight capability, ranging performance, and tracking precision are considered in the system performance tests; and various aspects of data handling are discussed. M.W.R.

N67-22373# Joint Publications Research Service, Washington, D. C.
TRANSISTORIZED RADIO BUOY
A. G. Sukhovey and V. S. Nazarov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 150–155 refs (See N67-22358 11-34) CFSTI: $3.00

Details are given on a transistorized receiving–transmitting apparatus which can be used both for radio direction finding of hydrological buoys in the distant zone, and for transmitting information from the buoy to the vessel. It consists of a radio transmitter operating in the 120 m range, a transmitting antenna with a grounded base and capacitive load, and a highly sensitive superheterodyne radio receiver. This equipment is placed on the buoy. The vessel carries a powerful radio transmitter for cutting in the buoy transmitter by interrogation, and a receiver. Advantages of the buoy radio station are cited as small size and weight; economical operation and a high degree of automation; and reliability and long life of the circuits used with the transistors. M.G.J.

N67-22374 Joint Publications Research Service, Washington, D. C.
A TELEMETRIC APPARATUS FOR CONVERSION AND TRANSMISSION OF SOME HYDROPHYSICAL PARAMETERS IN A BINARY CODE
V. G. Anblagov and A. F. Ivanov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 158–163a refs (See N67-22358 11-34) CFSTI: $3.00

A telemetric apparatus was developed for simultaneous data transmission from 16 sensors, with an accuracy of transmission through the communication channel of not less than 14 binary digits. The instrument consists of units for converting voltage into a code and for converting a parallel code into a series code; a control unit which includes a master oscillator, an eight digit binary counter, a diode decoder, and logic circuits; and an output stage. The operation of each component is described in detail. The maximum depth of submergence is determined by the strength of the container. The time of continuous operation is not less than eight hours. The apparatus normally functions in the temperature range from −10° to +50°C, and with ±20% deviations of the supply voltages from the nominal values. M.G.J.

N67-22384# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
INTERFEROMETER SIGNAL STATISTICS UNDER GENERAL SCATTER CONDITIONS
Edward J. Fremouw (Alaska Univ.) and John M. Lansinger Nov. 1966 33 p refs
(D1-82-0575; AD-643936) CFSTI: HC $3.00/MF $0.65

Analytical and numerical results describing the statistics of scattered signals observed interferometrically are presented. Observable quantities are given in terms of two wavefront parameters which are invariant in past-scattering propagation: the ratio of nonscattered to scattered flux and the wavefront autocorrelation. The analytical result refers to the average output of a phase-switch or coherently detecting phase-sweep interferometer. Numerical results are given for distributions and average characteristics of real amplitude-product and phase-difference, which are observable with phase-sweep interferometers employing other detection techniques. The treatment is based on the assumption of a randomly phased angular spectrum. However, no restrictions are placed on the degree of scatter or on the form of the autocorrelation function. Author (TAB)

N67-22396# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.
OPTIMAL FIXED-POINT CONTINUOUS LINEAR SMOOTHING
James S. Meditch Dec. 1966 28 p refs
(Contract N00014-66-C0020-A03)
(TR-66-108; AD-644250) CFSTI: HC $3.00/MF $0.65

The filter and error covariance equations for optimal fixed-point smoothing for continuous linear systems are developed. The development is carried out by considering the limiting case of the results for the same problem for discrete linear systems. The procedure is of use in estimation problems where a smoothed estimate of a continuous linear systems state is desired at some specified critical time during the systems operation. Four examples are presented to illustrate the results. Author (TAB)

N67-22402# Joint Publications Research Service, Washington, D. C.
INFORMATION VALUE AND SUFFICIENT STATISTICS IN THE OBSERVATION OF A RANDOM PROCESS
B. A. Grishanin and R. L. Stratonovich *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 2–14 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

The problem of finding the most valuable information in the observation of a random process is being investigated where the amount of information about the observed process is limited. It is shown that the device for formation of the most valuable information is divided into the unit for formation of sufficient statistics (sufficient coordinates) and the unit for formation of the transmitted information. The most valuable information is found, and its value calculated for two special cases in one of which the only essential sufficient coordinate is the similarity ratio, and in the other, the a posteriori mathematical expectancy. Author

N67-22427*# California Univ., Berkeley. Space Sciences Lab.
A GEOMETRIC TREATMENT OF THE PROBLEM OF SOURCE ENCODING A GAUSSIAN RANDOM VARIABLE
David J. Sakrison 31 Jan. 1967 21 p refs *Its* Tech. Memo Ser. No. 8, Issue No. 3
(Grant NGR-05-003-143)
(NASA-CR-83396) CFSTI: HC $3.00/MF $0.65 CSCL 09D

A geometric treatment of the source encoding of a gaussian random variable is presented. This first section is expository, giving a geometric derivation of Shannon's classic result which clearly shows the steps in source encoding and the properties that a near optimum code must possess. The second section bounds the performance that can be obtained with a finite block length of L random variables. It is shown that a code can be found whose performance approaches that of the rate distortion function as $1/L$ in mean-square-error and $\ln L/L$ in rate. Author

N67-22438*# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
GIANT APERTURE TELESCOPE STUDY Phase III Report
20 Feb. 1967 22 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951288)
(NASA-CR-83392; Rept.-8691) CFSTI: HC $3.00/MF $0.65

An engineering estimate of the costs associated with a particular configuration of a giant aperture telescope study is presented. Illustrations are presented of a 120-inch azimuth-elevation telescope, its installation in an elevated dome, and an optical schematic of the telescope and transceiver. The estimated first-unit costs of such an installation are given, and some of the pertinent details are outlined in tabular form. Summaries of significant results and conclusions, and a delineation of anticipated problem areas and recommended actions are included. C.T.C.

N67-22444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE FREQUENCY DETECTOR
L. Benes 12 Sep. 1966 22 p refs Transl. into ENGLISH from Slaboproudy Obzor (Prague), v. 25, no. 9, 1964 p 528–532
(FTD-HT-66-156; AD-644045) CFSTI: HC $3.00/MF $0.65

An explanation is given of the derivation of a new method for the obtainment of differential frequency of a pulse process from two input signals also of pulse process. Described is a pulse frequency detector with tunnel diodes and its properties are described in greater detail. The detector works with the summation of the signal giving at input a diphase voltage or differentiation frequency and the double value signal, carrying information about the positive or negative differentiation frequency value. Author (TAB)

N67-22493# Laboratori Elettronici e Nucleari, Milan (Italy).
PCM TELEMETRY FOR ELDO SATELLITE TEST VEHICLE
A. Bonanni, A. Magri, and U. Pellegrini *In* ELDO Tech. Rev., Vol. I, No. 3 p 173–189 Presented at the Natl. Telemetering Conf., Boston, 10–12 May 1966 (See N67-22491 11-31) CFSTI: HC $3.00/MF $0.65

Because of range, accuracy, and data handling advantages, a PCM telemetry system was to be developed for the satellite test vehicle of the ELDO program. The coder works at 50 kc/sec and is capable of receiving usual signals at low and high levels. Super-commutation is possible up to 16:1, and sub-commutation to 1:8. The power supply is pulse operated to reduce the consumption. The technology is based on transistorized printed circuit techniques, but the design is such as to facilitate the transfer to integrated circuits. At each stage of manufacture, the equipment is submitted to very severe environmental tests. Author (ESRO)

N67-22519# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A PRELIMINARY STUDY OF KLYSTRON DISTORTION IN A CHIRP RADAR SYSTEM
Harold M. Heggestad 28 Dec. 1966 41 p
(Contract AF 19(628)-5167)
(TN-1966-54; EDS-TR-66-602; AD-646346) CFSTI: HC $3.00/MF $0.65

A study was made of the effects of klystron saturation, and phase and amplitude distortion, on the performance of a wideband high-power CHIRP radar system. Mathematical analysis of a general non-linear model for a klystron indicates that satisfactory operation of the radar system can still be achieved in the face of the grossly non-ideal character of the tube, with suitable restrictions, if appropriate compensation is applied. Extraneous paired echoes in the signal at the klystron input (whether present because of previous distortion, or deliberately introduced by a transversal equalizer) are shown to have a specific relationship with paired echoes at the klystron output. A FORTRAN computer program has been written to simulate the performance in a CHIRP system of any suitable klystron (or other high-power amplifier tube, such as a twystron or TWT). The program simulates a pure CHIRP signal of that bandwidth and delivers plots of the weighted compressed pulse that would appear at the receiver output. In addition, by inspection of the output compressed pulse plots, one can estimate transversal equalizer settings to cancel the spurious sidelobes, introduce the equalized CHIRP pulse into the program in place of the former undistorted input, and observe the degree of compensation in the output pulse. The report includes reproductions of the output plots generated by the simulation program, for a representative set of klystron data. Author (TAB)

N67-22520# Systems Research Labs., Inc., Dayton, Ohio.
COLOR SIGNAL SOURCE FOR VISUAL SIMULATION Final Report, Apr. 1965–Mar. 1966
John H. Harshbarger Wright-Patterson AFB, Ohio, AMRL, Sep. 1966 53 p ref
(Contract AF 33(615)-2970)
(Rept.-827; AMRL-TR-66-116; AD-645140) CFSTI: HC $3.00/MF $0.65

A specialized color closed-circuit television camera system was developed as a source of high-quality signals to be used in simulation display device research programs. The system employs three vidicon camera tubes in conjunction with a unique optical and beam-splitting system. Camera configuration permits the system to be used as a three-color pickup, a multichannel monochrome signal source, or a high performance monochrome television signal source. The camera system contains four major units: camera, camera control, video inverter, and power supply unit. The camera is mounted on a special framework which also serves as a model or test chart support. The camera control, power supply, and color television monitor are placed in a rack cabinet. Wherever possible, standard circuit modules of high quality are employed in the system; this design approach provided a high degree of reliability even though the system represents a new approach to color television camera design. Author (TAB)

N67-22525# Naval Research Lab., Washington, D. C.
AN AMBIGUITY FUNCTION INDEPENDENT OF ASSUMPTIONS ABOUT BANDWIDTH AND CARRIER FREQUENCY
D. A. Swick 15 Dec. 1966 12 p refs
(NRL-6471; AD-645918) CFSTI: HC $3.00/MF $0.65

With the use of a mean-square difference criterion to distinguish echoes from two targets at different ranges moving with different velocities, an ambiguity function is derived. The concept of a modulated carrier is avoided, and the actual Doppler effect of time compression or expansion is used, rather than the more usual approximation of constant frequency shift. Thus this function can be applied to the very-low-frequency broadband signals sometimes employed in sonar systems. It reduces to the Woodward ambiguity function in the case of two targets of nearly equal velocity, and, in general, in a narrow-band approximation. Some properties of this ambiguity function are discussed. Author (TAB)

N67-22529# Navy Electronics Lab., San Diego, Calif.
APPLICATION OF LOGARITHMIC RECEIVERS TO SIGNAL DETECTION IN NON-STATIONARY BACKGROUNDS Research and Development Report, Aug.–Oct. 1961
R. H. Prager and F. L. Rees (Westinghouse Elec. Corp.) 18 Jan. 1962 32 p refs
(NEL-1098; AD-645328) CFSTI: HC $3.00/MF $0.65

A detailed theoretical treatment of the reduction of a class of non-stationary backgrounds to stationary ones using logarithmic receivers was developed. It is shown that the logarithmic receiver will perform this function on Rayleigh-distributed background and on the output of an OR-circuit having n Rayleigh-distributed inputs. The conditions under which the logarithmic receiver is an appropriate processing device were analyzed; two sufficient conditions on the probability density function of the background are derived. Author (TAB)

N67-22549# Electro-Voice, Inc., Buchanan, Mich.
LIGHTWEIGHT AUDIO ACCESSORIES Final Report 1 Jul. 1965–31 Oct. 1966
Ben T. Cochran Jan. 1967 34 p
(Contract DA-28-043-AMC-01542(E))
(ECOM-01842-F; AD-646941) CFSTI: HC $3.00/MF $0.65

The report contains a summary of the work performed for the design and construction of a lightweight and miniature type handset, headset, hand held microphone and telegraph key. Described in detail is the successful design and fabrication of these

four items which have been found acceptable from a human engineering viewpoint in addition to meeting all specified requirements in the electrical, acoustical, environmental and mechanical performance categories. Author (TAB)

N67-22616# TRG, Inc., Menlo Park, Calif.
DEVELOPMENT AND TESTING OF HF WIRE-GRID LENS ANTENNA, VOLUME II Final Report
E. M. T. Jones, R. L. Tanner, M. G. Andreasen, F. B. Harris, Jr., and E. D. Sharp Jun. 1966 286 p refs
(Contract FAA-ARDS-598)
(SRDS-RD-66-20; AD-646351) CFSTI: HC$3.00/MF$0.65

The report describes the results of a Joint Services Evaluation conducted in the Spring and Summer of 1964 on the first full-scale model of the Wire-Grid Lens HF Antenna, constructed for the FAA at their International Flight Service Receiver Station at Molokai, Hawaii. The lens employs a novel focusing medium consisting of two wire grids, one above the other, whose wave slowing or refractive characteristics are to first order independent of frequency. By locating feeds at many different points on the lens circumference, it becomes equivalent to many highly directive broad-band antennas pointed in many different directions. During the evaluation SRI and NRL made an extensive series of airborne pattern measurements on the lens, the FAA station rhombics, and several reference antennas using the SRI airborne pattern measuring equipment. These data were later reduced by SRI with aid of a computer to the form presented in this report. These patterns demonstrate the predicted directivity and beam forming properties of the lens at all azimuth angles over its 3 to 30 Mc design frequency band, which are comparable to those of the station rhombics over the 5 to 25 Mc band each of which operates over a more restricted frequency band. TAB

N67-22836# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTIONS OF THE STATISTICAL THEORY OF RADAR, VOLUME III
P. A. Bakut and I. A. Bol'shakov 28 Jun. 1966 843 p refs
Transl. into ENGLISH of the book "Voprosy Statisticheskoy Teorii Radiolokatsii" Moscow, Izd. Sovetskoye Radio, 1964 p 1–1079
(FTD-MT-65-47; AD-645775) CFSTI: HC$3.00/MF$0.65

The volume is dedicated to the theory of radar measurements and questions of target resolution. There is developed a general theory of radar measurements, containing an analysis of tracking and nontracking measuring systems both in linear approximation, and also taking into account their nonlinearity, and also synthesis of optimum systems of measurement of separate time-variable parameters of motion of targets and sets of them. On the basis of this theory there is conducted analysis and synthesis of range finding systems, systems of measurement of velocity and goniometrical systems. There are investigated cases of reception of both coherent, and also incoherent signals. In examining questions of target resolution there are investigated possibilities of resolution of signals reflected from them, and there are found receivers optimum from this point of view, and also optimum systems of resolution in regimes of detection and measurement of coordinates. In the course of development of theory there are revealed laws governing radar measurements and resolution of targets. Author (TAB)

N67-22858*# Massachusetts Inst. of Tech., Cambridge.
STATISTICAL COMMUNICATION THEORY
Y. W. Lee, A. G. Bose, J. D. Bruce, A. V. Oppenheim, D. E. Nelsen et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 181–201 refs (See N67-22641 11-34) CFSTI: HC$3.00/MF$0.65
(Grants NsG-496; NSF GK-835; Contract DA-36-039-AMC-03200(E))

Transfer functions for a two-state modulation system, and echo removal are discussed. The modulator transfer functions are derived for fixed- and ramp-input waveforms. The system proposed for separating one signal from a convolution of two or more signals is a nonlinear homomorphic system which obeys a generalized principle of superposition. Echoes, aperiodic and periodic wave signals are considered. Research objectives and preliminary work in related communication areas are also covered. N.E.N.

N67-22859*# Massachusetts Inst. of Tech., Cambridge.
PROCESSING AND TRANSMISSION OF INFORMATION
P. Elias, R. M. Gallager, M. M. Goutmann, F. C. Hennie, III, E. V. Hoversten et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 203–224 refs (See N67-22641 11-34) CFSTI: HC$3.00/MF$0.65
(Grants NsG-334; NsG-496; NSF-GP-835, Contract DA-36-039-AMC-03200(E))

Low rate upper bounds on error probability for fading dispersive channels is discussed, and a scatter communication channel is considered for transmitting amplitude information on some basic unit energy signal. Expressions are presented for the error probability, optimization, zero-rate upper bound, and rates greater than zero. The optical propagation through a turbulent atmosphere is also discussed, and a theoretical analysis is included of the geometric optics. An atmospheric model is described, emphasizing the behavior of the field at a single instant of time. Details on moments, ray-to-space transformations, and phase covariance are reported. Research on coding and decoding, and noisy channel networks are summarized. N.E.N.

N67-22860*# Massachusetts Inst. of Tech., Cambridge.
DETECTION AND ESTIMATION THEORY
H. L. Van Trees, D. L. Snyder, M. E. Austin, A. B. Baggeroer, L. D. Collins et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 225–252 refs (See N67-22641 11-34) CFSTI: HC$3.00/MF$0.65
(Contract DA-36-039-AMC-03200(E))

Equalization of dispersive channels using decision feedback is discussed, and the problem of determining the structure of a receiver for digital communication over a linear dispersive channel whose equivalent impulse response is known is considered. The structure of the decision feedback equalizer is developed, and is then modified for the minimum output sample variance feedback equalizer. A state variable approach for the processing of sonar or seismic array data in the presence of pure delay is also discussed. The derivation of the MAP estimation equations are presented, and the result is a set of differential difference equations with a two-point boundary value condition. Research in sonar, digital and analog communications, and random process techniques are summarized. N.E.N.

N67-22861*# Massachusetts Inst. of Tech., Cambridge.
SPEECH COMMUNICATION
K. N. Stevens, M. Halle, W. L. Henke, D. H. Klatt, A. V. Oppenheim et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 253–260 refs (See N67-22641 11-34) CFSTI: HC$3.00/MF$0.65
(Contract AF 19(628)-5661, Grant NIH 5-R11-NB-04332-04)

Continuing research to gain an understanding of the processes whereby discrete linguistic entities are encoded into speech by human talkers, and speech signals are decoded into meaningful linguistic units by human listeners is reported. The on-line operation of a real-time spectral input system for speech analysis is briefly outlined. An experiment is described in which it was determined that the phoneme boundaries for a set of vowels in consonantal context are the same for a child as for an adult. Air flow measurements during the production of fricative consonants in intervocalic position were taken, and the articulatory activities during the process are indicated. N.E.N.

N67-22683# Naval Ordnance Lab., White Oak, Md.
HYDRODYNAMIC TESTS OF HERCULES SEA UNIT KWO-1
Sherman L. Min 27 Sep. 1966 18 p ref
(NOLTR-66-200; AD-645695) CFSTI: HC $3.00/MF $0.65

The Lightweight Helicopter Remote Classification and Localization System (HERCULES) sea unit, XWO-1, was hydrodynamically tested. The results showed that the sea unit, with a 2 degree hydrophone, was tilted by a water current. By using a plexiglass fairing with the hydrophone, the tilting was greatly reduced. The tilting of the sea unit would reduce the effective range of the system. Several concepts are proposed to reduce the tilting problem. Author (TAB)

N67-22689# IIT Research Inst., Chicago, Ill. Technology Center.
CONTINUOUS FACSIMILE SCANNER EMPLOYING FIBER OPTICS Quarterly Report, 1 Apr.–30 Jun. 1966
Donald A. Pontarelli Sep. 1966 38 p
(Contract DA-28-043-AMC-00164(E))
(IITRI-A6093-24; ECOM-00164-8; QR-8; AD-644963) CFSTI: HC $3.00/MF $0.65

Design, fabrication, and testing of the modulator and amplifier are discussed in extensive detail. The design approach used has led to an operative equipment. Author (TAB)

N67-22695# Delaware Univ., Newark. Electrical Engineering Dept.
QUANTUM LIMITATIONS TO ELECTROMAGNETIC SIGNAL MEASUREMENTS Final Report, Jan. 1965–Dec. 1966
L. Paul Bolgiano, Jr. Dec. 1966 20 p refs
(Grant AF-AFOSR-2-65)
(AFOSR-67-0152; AD-645640) CFSTI: HC $3.00/MF $0.65

The report describes work on the development of an effective statistical communication theory for optical communications. Photodetection statistics have been computed for an optical illumination consisting of a cw signal and narrowband noise and a formula obtained for the information transmittable by an optical detector. Quantum electrodynamics has been used to evaluate the statistics of a narrowband optical communication system and to compute the statistics of a coupled mode system. The report summarizes this work and lists publications during the grant period. Author (TAB)

N67-22698# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EXPERIMENTAL STUDY OF SUBREFLECTOR SUPPORT STRUCTURES IN A CASSEGRAINIAN ANTENNA
Franklin I. Sheftman 23 Sep. 1966 35 p refs
(Contract AF 19(628)-5167)
(TR-416; ESD-TR-66-199; AD-646225) CFSTI: HC $3.00/MF $0.65

The effects of various support structures on the radiation patterns of a Cassegrainian antenna have been investigated experimentally. Detailed two-dimensional contour plots of the wide-angle radiation are presented primarily for support member dimensions up to about one wavelength. We show that the disturbing effects decrease rapidly for perpendicular polarization when the dimensions are decreased below wavelength/2. Furthermore, the on-axis geometrical shadowing due to the support members does not give the correct level and shape of the wide-angle radiation. Account must be taken of the polarization and orientation of the members relative to the antenna axis. The performance of dielectric members is shown to be generally poorer than that of metallic members. The alternative of supporting the subreflector with a thin-wall axial dielectric cylinder is shown to be electrically acceptable for thicknesses of the order of 0.01 wavelength. The data presented should be useful in designing and evaluating various types of support structures for Cassegrainian and front-fed reflectors. Author (TAB)

N67-22729# Communication Systems, Inc., Paramus, N. J.
A STUDY LEADING TO THE CONSTRUCTION OF A TROPOSCATTER SIMULATOR First Quarterly Report, 1 Jul.–30 Sep. 1966
M. S. Klein and J. Harvey Dec. 1966 50 p refs
(Contract DA-28-043-AMC-02545(E))
(ECOM-02545-1; CSI-66-TR-2298; RCS-OSD-1368; Rept.-1; AD-645503) CFSTI: HC $3.00/MF $0.65

Main areas of effort included: (1) study of previous simulators to analyze possible approaches, (2) analysis of troposcatter data to determine a suitable range of parameters, (3) creation of computer techniques for simulating multipath, (4) investigation and development of hardware. The study indicates that a computer-controlled simulator, utilizing a tapped delay line approach, will yield the most flexibility and utility and the highest degree of freedom. The highest observed fade rates reported in the literature, due to aircraft doppler, were between 40 Hz and 60 Hz, and delay spread on 200-mile hops apparently has not exceeded 1 microsecond. Values for delay drift have yet to be determined but appear to be limited to 400 nanoseconds. Considerable insight into computer simulation of multipath was obtained, and a prototype program was evolved for controlling a delay matrix. Investigations into several electronically-controlled attenuator configurations yielded two very -promising compact designs. A control network was tested, with satisfactory results. A study of possible delay line configurations was initiated. Author (TAB)

N67-22743*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE FAN METHOD OF DATA COMPRESSION
Lee D. Davisson (Princeton Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 23–30 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

The fixed nature of the fan method of data compression is described. This scheme relies on the approximation of the source time series by straight line segments. The longest line for which the maximum error is below a given threshold is found and used to approximate the data. The encoded message contains information about the length of the line and its starting and ending points. In this case, the code work length is reduced at the expense of decreased flexibility in the interpolation scheme which may or may not result in a net compression ratio decrease. The capability of this method relative to another such as straight run length encoding (zero order hold), where the number of consecutive samples at a given level is transmitted, depends on the data source distribution. It is concluded that the choice of predictor should be based on the data distributions. Because of the lack of uniform superiority of predictors of a fixed nature, it is perhaps better to use some adaptive technique if an accurate data model is lacking. R.U.

N67-22744*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CONCEPT OF ENERGY COMPRESSION RATIO AND ITS APPLICATION TO RUN LENGTH CODING
Lee D. Davisson (Princeton Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 31–43 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

The energy compression ratio is calculated for a particular coding scheme under particular assumptions about the data and channel probability models. This ratio is defined as the ratio of average energy required to send a sample in an uncompressed communication system to that required in a proposed compression system for the same data quality. This ratio is a function of the bit error rate in the compression system. To illustrate the nature of the energy compression ratio and the effect of timing errors on the received data, the probability of received sample error is used as the data cost function or quality measure. It is seen that the probability of received sample error is many times greater in the compressed system than in the uncompressed system for the same bit error rate. R.U.

N67-22745*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EFFECT OF CHANNEL ERRORS ON A SAMPLE COMPRESSION SYSTEM EMPLOYING BINARY SEQUENCE TIME ENCODING

Robert B. Kelley (Rhode Island Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 45–64 refs (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

A sample compression system, consisting of an encoder-decoder pair, employing binary sequence time encoding is briefly discussed in relation to the effect of channel errors on the system. The case is considered where the timing information is encoded as a binary sequence, one bit for each original data sample. Data and channel models, as well as sample compression and binary sequence time encoding concepts are outlined. The binary sequence error decoding rule is illustrated. Channel error is analyzed, and the dependence of the sample error probability on the channel bit error probability is shown by the curves of the upper bounds plotted. The approximation, from the upper bounds, appears to overbound the exact upper bound by a factor of about 4/3 for B=256. R.Li.

N67-22747*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INVESTIGATION OF THE RELIABILITY OF A PROPOSED CONFIDENCE LEVEL PROCEDURE FOR ERROR PROBABILITY OF A BANK OF CORRELATORS

D. A. Munn (Missouri Univ., Columbia) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 75–81 refs (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

The reliable confidence level for error probability of a bank of correlators is investigated. A formula is given for obtaining a confidence measure on an estimate of the signal-to-noise ratio at the correlator's output. When ratio R is applied to a phase coherent communication system, the resulting confidence measure is not reliable at low signal-to-noise ratios. This conclusion is reached by comparing the results of the case with no signal present to the cases with signal present. R.Li.

N67-22748*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NON-PARAMETRIC SIGNAL DETECTION

E. A. Feustel (Princeton Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 83–110 refs (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

A binary decision problem is formulated on a sampled waveform which contains noise alone, or noise and signal. The decision to be made is whether or not the signal is present in an interval of the waveform. The nonparametric signal detection of one variety of sub-optimum technique is studied. A special sub-class of nonparametric tests requires the calculation of rank statistics, and the effects of dependence of the observations on the resulting rank statistics are discussed. R.Li.

N67-22749*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A NOTE ON PHASE-LOCKED LOOPS IN SPACE COMMUNICATIONS

T. R. Williams *In its* 1966 Session of the Goddard Summer Workshop [1967] p 111–119 refs (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

Analogies for simple second-order phase locked loops are derived and discussed, and a simple method for graphical analysis is presented. It appears that the analogies and the method of graphical analysis can be usefully extended to cover more complex types of frequency-modulation receiving systems with feedback. Author

N67-22752*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIATION FROM A DIPOLE ANTENNA IMMERSED IN A HALF SPACE OF UNIAXIAL ANISOTROPIC PLASMA

M. Javid *In its* 1966 Session of the Goddard Summer Workshop [1967] p 225–237 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF$0.65

The geometry of the problem of radiation from a dipole antenna immersed in a half space of uniaxial anisotropic plasma is presented. A medium referred to as a uniaxial anisotropic medium with the optical axis oriented along the z axis is considered. It is assumed that the dipole is oriented along the optical axis, but the technique described is applicable to arbitrary orientations. The following concepts are discussed: the plane wave representation of the field of the dipole is free space, the field of dipole in unbounded uniaxial medium, and transmission coefficients. R.Li.

N67-22754*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A PLATE STUDY ASSOCIATED WITH REFLECTOR DYNAMICS OF THE ROSMAN-1 ANTENNA

Y. Chen and T. G. Toridis (George Washington Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 243–245 (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

For satellite tracking application, a detailed study of the dynamics of the paraboloidal reflector of the Rosman-I antenna was conducted. The Rosman-I antenna consists of an 85-foot diameter parboloidal reflector mounted on X and Y gears that are supported by a tower structure. The radio signal receiving system is located at the focal point of the paraboloidal reflector. The effect of the dynamic forces induced in the structure due to mechanical disturbances is to produce deformations of the antenna structure as a whole. Such deformations of the antenna result in deviations of the reflecting surface from a true paraboloid and displacement of the receiving elements from the focus of the paraboloid. This results in signal distortion, and limits the accuracy of the antenna. R.Li.

N67-22755*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FREQUENCY RESPONSE OF THE ROSMAN I 85-FOOT DISH ANTENNA

Jean M. Dalrymple *In its* 1966 Session of the Goddard Summer Workshop [1967] p 247–252 refs (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

A technique was developed for producing spectrum analyzer charts from which frequency, amplitude, and damping factor could be obtained. A table is given listing results from seven sensors due to impulse excitation at the antenna. Details of the Rosman I 85-foot dish antenna frequency response which need cross-checking are briefly discussed. R.Li.

N67-22756*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CALCULATION OF RADIATION PATTERN OF ROSMAN 85-FOOT PARABOLOIDAL DISH

George Eichmann *In its* 1966 Session of the Goddard Summer Workshop [1967] p 253–269 refs (See N67-22741 11-34) CFSTI: HC$3.00/MF$0.65

Existing results in the area of finite paraboloidal reflectors are summarized, and their applicability to the problem of radiation from the Rosman I distorted paraboloidal dish with offset feed are evaluated. Methods to calculate radiation patterns of the Rosman 85-foot paraboloidal dish are suggested. R.Li.

N67-22757*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ANALYSIS OF THE DYNAMIC RESPONSES OF THE ROSMAN-I ANTENNA

William J. Irwin *In its* 1966 Session of the Goddard Summer Workshop [1967] p 271–275 (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

In an analysis of the dynamic responses of the Rosman-I antenna, two series of tests were run, the first with X axis servo modulation, the second with Y axis modulation. A general description is given of the project to find a transfer function relating signal distortion (created by wind, servo driving torque, and servo starting transients) to servo output. R.Ll.

N67-22781# Royal Aircraft Establishment, Farnborough (England).
CENTURY CODED TIMING FORMAT
E. S. Mallett Nov. 1965 15 p refs
(RAE-TR-65249; AD-478913) CFSTI: HC $3.00/MF $0.65

A description is given of a coded timing system for use on R.A.E. ranges, with reasons for the choice of the particular format. Author (TAB)

N67-22844*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
COMMUNICATIONS SYSTEM FOR ZERO-G SIMULATION IN WATER
H. E. Smith 6 Dec. 1966 17 p
(NASA-TM-X-53547) CFSTI: HC $3.00/MF $0.65 CSCL 17B

This report presents a description of a two-way communications system connecting nine personnel stations and a public address system. The system includes underwater speakers that can be heard by the safety divers. Operating instructions for the system are also given. Author

N67-22877*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE USE OF PARITY BIT IN A TELEMETRY SYSTEM
Warner Miller, Ronald Muller, and John Yagelowich Mar. 1967 16 p
(NASA-TM-X-55744; X-562-67-123) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The use of parity in a pulsecode modulated (PCM) telemetry system is described. Parity performance curves are shown for several word lengths when the signal is in a noisy channel. Advantages of using parity over uncoded PCM works is shown to be 2.4 to 2.6 db. Other advantages are listed. Author

N67-22919 Bolkow Entwicklungen K. G., Munich (West Germany).
ON THE TECHNOLOGY AND UTILIZATION OF TELEVISION AND ULTRA SHORTWAVE RADIO BROADCASTING SATELLITES [ZUR TECHNIK UND NUTZUNG VON FERNSEH- UND UKW-RUNDFUNKSATELLITEN]
Erwin H. Soiderer [1966] 38 p refs In GERMAN Presented at the DGRR Symp. on Satellite Technol. No. 2, Munich, 8 Dec. 1966
(RF-78-O; DK-66-121) CFSTI: $3.00

Reviewed are such technical requirements as antenna configurations, stabilization, power sources, output, and radiative heat transfer in space. Two satellite concepts are outlined: one is powered by a large solar cell system, the other has a nuclear electric power source. For the nuclear-powered satellite, an increase in payload during orbital transfer with electric propulsion is discussed and compared with the Hohmann transfer. Applicability of satellite radio and television transmission is considered for several land regions of the earth. Transl. by K.W.

N67-22929 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR AUGUST 1966
1966 48 p *Its* Issue No. 28
CFSTI: $3.00

Data tables containing times, azimuths, and elevations as observed during August 1966 are presented for the following: Transit 1B Satellite (1960 03 B), Ariel 1 Rocket (1962 15 B), Thor Agena D (1963 03 A), Explorer 17 Satellite (1963 09 A), Thor Agena B (1963 27 A), Dash 2 (1963 30 D), Ablestar Rocket (1963 38 A), Polyot 1 Satellite (1963 43 A), Nimbus 1 Satellite (1964 52 A), Nimbus 1 Rocket (1964 52 B), Explorer 24 Satellite (1964 76 A), Cosmos 54 Rocket (1965 11 D), Cosmos 58 Satellite (1965 14 A), Cosmos 58 Rocket (1965 14 B), Agena D Rocket (1965 16 J), Cosmos 71 Rocket (1965 53 F), Pogo 2 Rocket (1965 81 B), Cosmos 97 Rocket (1965 95 B), Pageos A (1966 56 A), and one unidentified observation. K.W.

N67-22931 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR SEPTEMBER, OCTOBER, AND NOVEMBER 1966
1966 56 p *Its* Issue No. 29, Pt. I
CFSTI: $3.00

Data tables containing times, azimuths, and elevations as observed during September, October, and November 1966 are presented for the following: Echo I Satellite (1960 09 A), Ariel 1 Satellite (1962 15 A), Ariel 1 Rocket (1962 15 B), Star-rad (1962 58 A), Injun 3 Rocket (1962 67 F), Thor Agena D (1963 03 A), Midas 7 (1963 30 A), Dash 2 (1963 30 D), and Explorer 19 Satellite (1963 53 A). K.W.

N67-22935 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR SEPTEMBER, OCTOBER, AND NOVEMBER 1966
1966 42 p *Its* Issue No. 29, Pt. 2
CFSTI: $3.00

Data tables containing times, azimuths, and elevations as observed during September, October, and November 1966 are presented for the following: Echo 2 Satellite (1964 04 A), Ariel 2 Satellite (1964 15 A), Explorer 24 Satellite (1964 76 A), Cosmos 71 Rocket (1965 53 F), Cosmos 97 Satellite (1965 95 A), Cosmos 97 Rocket (1965 95 B), Pageos A (1966 56 A), and several unidentified observations. K.W.

N67-22960# Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Telecommunications Research.
ANNUAL REPORT 1965–1966
1966 16 p refs
(CSIR-TEL-60) CFSTI: HC $3.00/MF $0.65

A summary description is given of research projects conducted in the following areas: radio wave propagation, radio noise levels below 30 Mc/s, radar echoes from precipitation, advanced radio techniques, radio astronomy, and radio and space research (e.g., the Deep Space Instrumentation Facility, mobile tracking station, and the Satellite Tracking and Data Acquisition Facility). L.E.W.

N67-23043# Stanford Research Inst., Menlo Park, Calif.
RADAR BENIGN/NON-BENIGN ENVIRONMENTAL ANALYSIS

Allen J. MacKinnon Dec. 1966 50 p refs Revised
(Contract Nonr-2332(00))
(ORD-RM-2167-1; AD-643217) CFSTI: HC $3.00/MF $0.65

The report describes the major system methodologies pertinent to the evaluation of contemporary fire control systems. It will serve as a useful reference for the systems analyst and as an aid for those who want to supplement their knowledge of the methodologies associated with radar systems analysis. Major emphasis is given to the description of radar performance in a benign and a nonbenign environment. Author (TAB)

N67-23047# Army Electronics Labs., Fort Monmouth, N. J.
APPLICATION OF THE LAND COLOR-VISION EFFECT TO TELEVISION SYSTEMS A Feasibility Study
Charles A. Fenton Dec. 1966 21 p refs
(RCS-OSD-1366; ECOM-2782; AD-645444) CFSTI: HC $3.00/MF $0.65 p

The findings of Edwin H. Land in his experiments on the color-vision process in man indicate that the human eye can distinguish practically all the colors of the spectrum in an image that has been constructed using only two discrete colors of light, whereas the conventional theories of color vision maintained that a minimum of three colors was necessary. A study was undertaken, therefore, to test the feasibility of displaying the Land-effect on a closed-circuit television system. Lands experimental arrangements were duplicated, using photographic film, to ensure a familiarity with the techniques and type of results to be expected. The method was then adapted to the television system, and it was found that the results so obtained were equal, if not superior, to those obtained with photographs. Although images produced by this two-color method lacked some of the fine distinguishability of hue and saturation available in a three-color system, it was concluded that the use of the Land-effect in electronic display devices would be advantageous in situations where a true rendition of the colors of a scene is not required but where a variety of colors is helpful in increasing clarity or in presenting information that could not be rendered in black and white. It should also be of interest in cases where the picture does not have to be of standard commerical broadcast quality. Author (TAB)

N67-23060# Naval Avionics Facility, Indianapolis, Ind. Applied Research Dept.
UHF TELEMETRY CONVERSION STUDY
Walter L. Wusser 1 Aug. 1966 125 p refs
(NAFI-TR-753; AD-645930) CFSTI: HC $3.00/MF $0.65

The report covers an analysis of the system problems arising from the conversion of Tartar, Terrier, and Standard missile telemetry from VHF to UHF and provides recommendations on how this conversion can be accomplished. These recommendations are based on minimizing the amount of system redesign by using as many major components of the existing system as is possible, consistent with the economic and performance requirements. The study is based on a fundamental analysis of the RF system links and includes those parameters which affect the performance of the cooperative doppler scoring subsystem. The doppler scoring subsystem shares one missile transmitter and antenna subsystem with the telemetry system and also includes a target subsystem and certain portions of the Shipboard Telemetry subsystem. Author (TAB)

N67-23063 Ionosphären-Institut Breisach (West Germany).
MEASURED ANTENNA PATTERNS OF SHORT WAVE RHOMBIC ANTENNAS [GEMESSENE ANTENNENDIAGRAMME VON KURZWELLEN-RHOMBEN]
B. Dold Mar. 1966 31 p In GERMAN; ENGLISH summary
(118-18) CFSTI: HC $3.00/MF $0.65

The radiation patterns of two rhombic antennas were measured by an airplane on frequencies 16, 18, 20, 22, 24, and 26 MHz, and the antenna gain was calculated. The measured patterns are given. Gains, beamwidth, and elevation angle for maximum radiation are plotted as a function of the frequency. Author

N67-23099# Technische Hogeschool, Eindhoven (Netherlands).
ON THE THEORY OF LINEAR NOISY SYSTEMS
Hendrik Bosma (Ph.D. Thesis) [1967] 203 p refs
CFSTI: HC $3.00/MF $0.65

The theory of linear noise systems is considered, based on the formal separation of noise properties from signal properties independent of the specific variables which have been chosen to describe noise and signal phenomena in a system. A mathematical formalism is developed for a general coordinate description of the exchange of noise and signal power between different parts of a system. Care is taken to prove the consistency of the formalism with the laws of thermodynamics. Prior to the development of the formulation in a general coordinate system, a discussion is given on the scattering-matrix representation of multiports. It is shown that the power–density matrix of the primary noise coordinates of a multiport can be written as a product of two matrices: the noise–temperature matrix and the noise-distribution matrix. Specific topics examined include noise and signal performance, coordinate transformations and imbeddings, diagonalization, and optimization of noise performance. L.E.W.

N67-23106# Radio Corp. of America, New York. CSD Advanced Communications Lab.
SIGNAL ENHANCEMENT TECHNIQUES Quarterly Progress Report, 1 Aug.–31 Oct. 1966
B. Bossard and P. Torrione Jan. 1967 40 p refs
(Contract DA-28-043-AMC-02280(E))
(RCS-OSD-1366; CR-66-565-39; ECOM-02280-2; Rept.-2; QPR-2; AD-645892) CFSTI: HC $3.00/MF $0.65

The report contains a theoretical study of the sources of noise in a varactor P-N junction. The purpose of this study was to determine whether the noise which is exhibited in the junction has a correlation property which can be utilized in the parametric amplifier circuit to reduce the total amount of output noise power. Experiments were conducted in which a parametric amplifier was demonstrated which exhibited the property of extremely low noise and also the ability to receive signals which appear to be imbedded in noise. Prior work in this area was primarily concentrated on analyzing the phenomenon of pulse width modulation by a parametric amplifier with large pump voltage swing. It appeared that pulse width modulation could result in amplification but not necessarily low noise. However, pulse width modulation when examined on a sampling basis could conceivably be able to reduce the total noise of the system with a sacrifice of sampling the information. Hence, for voice-type communication, it is possible that sampling could enhance the signal-to-noise ratio and still allow for a reasonable reception of an audible signal. This report also contains a technique which is being developed under this contract in which a signal can be received in the presence of a large interfering signal even though the sidebands of the interference overlap those of the desired signal. TAB

N67-23143# Aeronutronic, Newport Beach, Calif.
SOLID STATE SCATTERING THEORY FOR LOCALIZED DEFECTS Final Report, Oct. 1965–Oct. 1966
A. J. Hughes Oct. 1966 85 p refs
(Contract AF 19(628)-5660)
(U-3926; AFCRL-66-763; AD-646272) CFSTI: HC $3.00/MF $0.65

Solid state scattering theory for localized defects has been developed in a manner applicable to a wide variety of defects. The group theoretic properties of Bloch functions and Wannier functions have been developed and have proven useful as a means of greatly reducing the complexity of the defect problem. Several points of principle concerning the Wannier functions have been

resolved. The method and techniques which have been developed are applied to the case of neutral vacancy in silicon. It is found that the vacancy produces a localized state in which low lying energy bands - in particular the lowest two valence bands - and interband couplings, are important. This is in contrast to the results for the shallow acceptors and donors which have been studied in the past. The energy for the bound state of the neutral silicon vacancy is obtained and found to be in moderate agreement with experiment. The general method which is developed appears to be the most powerful approach presently available for the investigation of the properties of localized defects. Author (TAB)

N67-23144# RAND Corp., Santa Monica, Calif.
OPTIMAL FILTERING FOR CORRELATED NOISE
R. S. Bucy Sep. 1966 20 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5107-PR; AD-646275) CFSTI: HC $3.00/MF $0.65

The Kalman-Bucy theory of linear filtering for observations corrupted by white noise is extended to colored noise problems without state augmentation. By considering natural correlated case definitions of controllability and observability, the stability, steady-state existence, and uniqueness are shown to be consequences of the theory for the white noise filter. Author (TAB)

N67-23158# Environmental Science Services Administration, Boulder, Colo.
AN HF ANTENNA ARRAY ELECTRONICALLY SCANNED IN ELEVATION
R. G. Fitzgerrell, L. L. Proctor, and A. C. Wilson Nov. 1966 35 p refs
(IER-11-ITSA-11; AD-645233) CFSTI: HC $3.00/MF $0.65

An HF receiving antenna array was constructed which is capable of electronically scanning a sector in elevation with a single, narrow, main lobe. It was incorporated into a system designed for ionospheric propagation studies which were to investigate the vertical angle-of-arrival of downcoming radio waves. The vertical broadside array consists of ten 12-MHz to 25-MHz, horizontally polarized, log-periodic-dipole element antennas stacked with uniform spacing on a 152-m tower. The sector of scan is dependent upon the element antenna spacing, and varies with frequency. This sector is from 3 degrees to 51.4 degrees at 12 MHz, and is from 1.5 degrees to 22 degrees at 25 MHz. The half-power beamwidth of the main lobe varies from about 7 degrees to 3 degrees over the same frequency range. The main lobe also of the array was scanned by varying the number of periods in the sinusoidal illumination function which was applied to the array. This scanning was effected electronically at an IF frequency, thus placing essentially no bandwidth restriction due to scanning upon the r-f input circuitry. The fundamental scan-timing frequency was 524 Hz. Each increment of the scan sector was actually scanned twice, however, once in each direction during a scanning cycle. Author (TAB)

N67-23159# Environmental Science Services Administration, Boulder, Colo.
TRANSMISSION LOSS AND SPACE DIVERSITY MEASUREMENTS OVER A MOUNTAIN DIFFRACTION PATH
L. G. Hause and C. F. Peterson Nov. 1966 59 p refs
(IER-12-ITSA-12; AD-645234) CFSTI: HC $3.00/MF $0.65

In July and October of 1965, tropospheric propagation measurements were made over a 223 kilometer mountain-obstacle diffraction path in Colorado using frequencies 0.9, 4.6 and 9.2 GHz. The July investigation was a continuation of work previously reported, and was conducted to obtain additional information on the time variability of basic transmission loss over mountain-obstacle paths. The October measurement program was expanded to yield information concerning the horizontal and vertical distribution of basic transmission loss in a plane perpendicular to the path. In addition to movable antennas, a second receiver on 4.6 GHz was installed with a combiner to obtain statistics on space diversity improvement. The data presented here include a comparison of height gain effects over the entire diffraction path with line-of-sight height gain effects over the path between the diffracting obstacle and the receiving site. Variations of transmission loss dependent on horizontal distance perpendicular to the propagation path are also discussed. Conclusions are drawn concerning the proper methods of deploying antennas to take maximum advantage of space diversity on this type of path. Author (TAB)

N67-23273*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
SYSTEM OPTIMIZATION FOR A LARGE INFORMATION COLLECTION SYSTEM Scientific Report
N. W. Perks 10 Mar. 1967 111 p refs /tr Scientific Rept.-292
(Grant NsG-134-61)
(NASA-CR-83546) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Large data collection systems are investigated, particularly the processes which result in lost information. A comparison is made of the sensitivity of different system configurations to information loss by overloading the receiving or serving mechanisms with random signal arrivals, and errors of symbol interpretation due to propagation through a noisy and fading channel. The channel is assumed to have additive, white Gaussian noise, and a Rician fading structure. The types of systems operation examined include sequential interrogation of the data sources, and random arrivals with or without signal separation capabilities. The servicing mechanism is examined for information lost considering such factors as arrival rate, number of receivers, independent or dependent operation, and the number of redundant data periods per transmission for each source. Author

N67-23339*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR SPACECRAFT TELECOMMUNICATIONS
Charles Kirsten 15 Mar. 1967 21 p
(Contract NAS7-100)
(NASA-CR-83553; JPL-TR-32-1105) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Subsystem implementation and performance of the on-board Surveyor telecommunications system is described. Covered are basic system capabilities, antennas, transmitters, receivers, signal processing, and the command subsystems. A study of redesigning requirements includes corrections of high voltage ionization and omniantenna sticking. K.W.

N67-23347# Astro Technology, Mountain View, Calif.
TRACK TELEMETERING PROPAGATION STUDY Final Report
D. B. Davis and N. C. MacLeod 22 Sep. 1966 139 p refs
(Contract AF 29(600)-5514)
(MDC-TR-66-114; AD-644908) CFSTI: HC $3.00/MF $0.65

The report describes the telemetry propagation characteristics of the AFMDC test track when operated at L and S-band frequencies, and based on this data, an estimate of the cost of changing to these bands from the present 800 MHz band is presented. The report is intended to be self sufficient in that all reference drawings of the track configuration which influence the propagation characteristics are included. The mathematical models for various propagation characteristics are derived and compared to experiment. All available data on present and proposed use of the 1400 and 200 MHz bands by nearby facilities are presented in tabular and graphical form. The influence of the current IRIG Standards on system operating in the 1400 and/or 2200 MHz bands is studied and described. A system block diagram for the system changeover from 800 MHz to the 1400 and/or 2200 MHz bands, together with descriptive text and a cost breakdown is included. Author (TAB)

N67-23350# Air Force Cambridge Research Labs., Bedford, Mass.
TIME CORRELATIONS OF SHORT SAMPLES OF MF AND HF SIGNALS RECEIVED AT SEPARATED STATIONS
J. E. Rasmussen and E. A. Lewis Oct. 1966 32 p refs *Its* Phys. Sci. Res. Papers No. 276
(AFCRL-66-696; AD-646256) CFSTI: HC $3.00/MF $0.65

Pulse envelopes from 1.95 MHz Loran transmitters were received at two synchronized stations 67 km apart and compared using a simple visual method to obtain arrival time differences. For a transmitter at 210 km distance the average measured groundwave arrival time difference agreed with the calculated value to within 1.3 microsec. For the skywave components from the same transmitter the average time difference changed from day to night, with typical random variations of 4 and 16 microsec, respectively. For skywaves from a transmitter at 500 km distance, observed with a different baseline orientation, the corresponding figures were 2 and 9 microsec. Brief daytime observations of the time signals from the 7.335 MHz station CHU, at 440 km distance, showed an average scatter of about 12 microsec. The data is too limited to permit any firm conclusions to be drawn about the implications of this technique to direction finding, but the magnitudes of the equivalent bearing fluctuations indicate there may be interesting possibilities in this regard. Author (TAB)

N67-23379# Communication Systems, Inc., Paramus, N. J.
WIDEBAND DIGITAL MODULATION AND DETECTION TECHNIQUES FOR TROPOSCATTER Quarterly Report, Jul.–Sep. 1966
E. Levine, R. T. Adams, and P. Grobert Jan. 1967 45 p refs
(Contract DA-28-043-AMC-02542(E))
(ECOM-20542-1; CSI-67-TR-2306; QR-1; AD-645571) CFSTI: HC $3.00/MF $0.65

The objective of this investigation is to identify and implement in breadboard from the technique offering the best performance in the transmission of high digital data rates (primarily 2.3 mbps) over tactical troposcatter paths of 50 to 150 miles at 5 gHz. The study is concerned with higher order modulation coding and other techniques that may bring about an optimal match to counteract the fading and multipath variation normally encountered on tropocatter circuits. A preliminary analysis was made of several modulation techniques, both conventional and newly proposed, with emphasis on attaining the desired bit rates in the presence of multipath propagation. Another consideration which was given some attention was the desirability of exchanging maximum bit rate capacity for single antenna in-band diversity under certain conditions. An experimental investigation of several proposed circuit techniques was also initiated. This work was limited to active filter circuits applicable to any coherent detection scheme likely to be chosen for implementation. The results of this work were favorable, indicating feasibility of key elements in such a filter. Author (TAB)

N67-23404# Joint Publications Research Service, Washington, D. C.
EFFECTS OF THE ATMOSPHERE ON THE CHARACTERISTICS OF MAXIMUM-SIZE RADIOTELESCOPES
N. A. Yesepkina, N. L. Kaydanovskiy, D. V. Korol'kov, B. G. Kuznetsov, and S. E. Khaykin 31 Jan. 1967 14 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 2, no. 8, 1966
(JPRS-39710; TT-67-30359)

The atmospheric influence on a variable-profile reflector type of antenna is investigated. An estimation is made of antenna power losses due to surface irregularity, scattering, and the horizontally extended type for the centimeter and millimeter wavelengths. C.T.C.

N67-23405# Joint Publications Research Service, Washington, D. C.
SYNTHETIC TELEPHONY
A. A. Pirogov 30 Jan. 1967 106 p refs Transl. into ENGLISH of the book "Sinteticheskaya Telefoniya" Moscow, Svyaz'izdat, 1963 p 1–120
(JPRS-39705; TT-67-30354)

A broad discussion is given of the current works and projects being conducted in synthetic telephony techniques. Emphasis is placed on long distance telephone communications in which these techniques offer the possibility of a reduction in the frequency spectrum. Consideration is given to some characteristics of voice signals and problems in studying the quality of a speech sound. The development of synthetic telephony methods are evaluated, and orthogonal systems of speech systhesis and basic voice tone discrimination methods are investigated. A summary of significant results and conclusions, and a delineation of anticipated problems areas and recommended actions are included. C.T.C.

N67-23419# Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.
AUTOMATIC TV AUDIO CUEING/DUBBING SYSTEM
Soichi Iwamura, Junichi Ishida, and Tsuguo Ohtani Jan. 1967 17 p *Its* Serial No. 106
CFSTI: HC $3.00/MF $0.65

Partial recording of the picture (including dialogue) by VTR has been widely practiced. However, it is impossible to use partial recording of dialogue, sound effects, and music in television audio composition. To solve this problem, we developed a multi-audio VTR and an automatic television audio editor for starting sound-effects tape automatically. Author

N67-23436# Sperry Rand Research Center, Sudbury, Mass.
BACKSCATTER SIGNATURE STUDIES FOR HORIZONTAL AND SLANT RANGE VISIBILITY Interim Report
Richard T. Brown, Jr. Dec. 1966 55 p
(Contract FA-65-W-1315)
(RD-66-76)

Results are presented of a study of backscatter signatures indicative of horizontal and slant visual range. The physics of the concept is described in terms of mathematical relationships between the backscatter signatures and the atmospheric extinction coefficient. An experimental program is described which tests the backscatter signature concept utilizing a Q-switched ruby laser and an off-axis optical backscatter receiver. The experimental data are compared with transmittance as measured by transmissometers located at the experimental test sites. The results verify and support the prior theoretically implied behavior of the backscatter signature system. This study indicates that such backscatter signature system for measuring extinction coefficients is feasible and warrants further investigation. Author

N67-23454# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
PROPAGATION AT 5 GHz IN EUROPE. A COMPARISON OF PREDICTIONS AND MEASUREMENTS FOR VARIOUS TYPES OF PATHS
C. F. Peterson, J. E. Farrow, F. M. Capps, and C. A. Samson Jul. 1966 132 p refs
(IER-2-ITSA-2) CFSTI: HC $3.00/MF $0.65

Received signal levels were measured over several military communication links in Europe operating in the band between 4.4 and 5 GHz. The propagation paths involved were of three types, namely, line-of-sight, mountain-obstacle diffraction, and tropospheric scatter. These measurements were made in the course of the development and the refinement of a system test plan. Pertinent system parameters such as line loss, antenna gain and transmitter power were obtained as a by-product of the test plan, and were utilized in the conversion of the received signal levels to basic transmission loss values. Calculations were made of the transmission loss distributions to be expected over the various paths and are

compared with those derived from the measurements. A prolonged space wave fadeout occurred over one of the mountain-obstacle diffraction paths. This fadeout is analyzed in detail and a correlation with meteorological conditions along the path is illustrated. Author

N67-23458# Joint Publications Research Service, Washington, D. C.
EFFECTS OF A TURBULENT TROPOSPHERE ON THE PARAMETERS OF A LINEAR ARRAY ANTENNA
A. N. Lomakin 2 Feb. 1967 12 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 8 1966 p 29–35
(JPRS-39736; TT-67-30384) CFSTI: HC$3.00/MF$0.65

Evaluated is the reduction of the coefficient of the radiation pattern and the expansion of the main lobe of the average radiation pattern of a linear antenna, stipulated by the influence of a turbulent troposphere. The basis of the computation of these effects is the structural function of the wave phase which follows from the Kolmogorov–Obukhov turbulence theory. Author

N67-23470# Travelers Research Center, Inc., Hartford, Conn.
MOVEMENT AND PREDICTABILITY OF RADAR ECHOES
James Warren Wilson Norman, Okla., Natl. Severe Storms Lab., Nov. 1966 29 p refs
(Contract CWB-11093)
(IERTM-NSSL-28)

Quantitative weather radar data was analyzed with high speed computers to investigate the movement and predictability of weather radar echoes. The location of the maximum cross-correlation coefficient between two echo patterns is used for measuring the movement and predictability of the echo patterns. An equation is developed for converting the magnitude of the cross-correlation coefficient to percent "hits." Regression equations specify the predictability of an echo pattern based on the individual pattern's statistical properties. Over two-thirds of the variance in the predictability can be explained by scale and intensity parameters of the echo patterns. Filtering techniques have been applied to the data to investigate the velocity and predictability of different scale features within the pattern. Features with wavelengths less than 20 mi. have little or no predictability for periods greater than 20 min., and their velocity is close to the mean wind velocity between 10,000 and 20,000 ft. The predictability of larger-scale features often remains high for hours; these features move to the right of the smaller-scale features and their speed is generally less. Author

N67-23472# Royal Aircraft Establishment, Farnborough (England).
A COMPARISON OF THE PERFORMANCE OF TELEVISION TRANSMISSION SYSTEMS USING AMPLITUDE MODULATION AND FREQUENCY MODULATION
H. Drysdale Feb. 1966 52 p refs
(RAE-TM-WF-1201(E)) CFSTI: HC$3.00/MF$0.65

The paper compares the performance of some types of amplitude modulated and frequency modulated systems, for transmitting television type signals, on the basis of the calculated signal to noise ratio obtained for systems having transmitters of the same peak power output. The treatment includes a review of the work of various authorities and then evaluates the signal to noise ratio for the case of receiver I.F. amplifiers having both rectangular and gaussian shaped response curves. The final comparison of the systems using television type signals has been given for I.F. amplifiers having rectangular shaped response curves. Author

N67-23477# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
CONTROL OF ERROR PROPAGATION IN CONVOLUTIONAL CODES
Daniel D. Sullivan (Ph.D. Thesis) Nov. 1966 98 p refs
(Grant NSF GP-2547)
(EE-687)

The design of systems and techniques utilized in ascertaining information content and in the development of significant, efficient coding mechanisms were studied. The error propagation problem was introduced within the framework of the parity parallelograms. Two classes of self-recovering codes were considered. The Massey orthogonalization scheme for definite decoding of uniform codes was shown to be optimum in the sense that no other scheme requires a lower syndrome memory. A method was also introduced to combat error propagation in codes which are not guaranteed to be self-recovering and which cannot be orthogonalized over all time for definite threshold decoding. Finally the results of computer simulations were presented and alarm techniques for detecting propagation situations were covered. C.L.W.

N67-23479# Catholic Univ. of America, Washington, D. C.
ELECTRICAL ENGINEERING RESEARCH REVIEW NO. 5
Jun. 1966 34 p refs

Abstracts are presented of unpublished research papers based on work performed in fulfillment of graduate thesis requirements. These papers describe research in the areas of ultrasonics in solids, instrumentation, electronic design, acoustics, dielectrics, solid state, and statistical data reduction. C.L.W.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-21988# Agrophysical Inst. (USSR).
INTEGRATING DEVICE FOR THE DETERMINATION OF TOTALS AND AVERAGES OF SOME METEOROLOGICAL ELEMENTS
A. F. Chudnovskii and B. M. Mogilevskii *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 22–27 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF$0.65

Details are given on an electronic integrated circuit using storage capacity as an integrating element for the first integration stage. This version represents an electronic circuit for the integration of small input voltages. Formulas are derived for determining the characteristics and values of the device. The instrument is provided with a clock mechanism whose moving contact makes it possible to set any desired time of integration up to three days with an accuracy of 10 minutes. It can also be operated as a multichannel integrator. M.G.J.

N67-22319# Argonne National Lab., Ill.
FORTRAN SUBROUTINES FOR HOUSEHOLDER'S METHOD IN THE COMPLEX CASE AND EIGENSYSTEMS OF HERMITIAN MATRICES
Dennis J. Mueller Jul. 1966 31 p refs
(Contract W-31-109-ENG-38)
(ANL-7231) CFSTI: HC$3.00/MF$0.65

Fortran subroutines that use Householder's method to reduce a complex matrix to upper Hessenberg form in which the lower subdiagonal is real are presented. A separate subroutine is given for hermitian matrices. Here the reduced matrix is real, symmetric, and tridiagonal. Its eigensystem can be calculated by a standard routine given in the appendix. A subroutine is included, which transforms eigenvectors of the reduced matrix to those of the original matrix. Author (NSA)

N67-22321# California Univ., Livermore. Lawrence Radiation Lab.
A COMPUTER-ORIENTED NEUTRON DATA STORAGE AND RETRIEVAL SYSTEM
W. J. Cahill, D. W. Thompson, S. T. Perkins, and R. J. Howerton Sep. 23, 1966 35 p *ref*
(Contract W-7405-ENG-48)
(UCRL-50132) CFSTI: HC $3.00/MF $0.65

A machine-independent, computer-oriented neutron data storage and retrieval system is described. Author (NSA)

N67-22336# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
FORTRAN II COMPUTER PROGRAM FOR ANALYSIS OF ELLIPSOMETRIC DATA
C. A. Larson 6 Dec. 1966 22 p refs
(Contract AT(29-1)-1106)
(RFP-729) CFSTI: HC $3.00/MF $0.65

An accurate and time-saving procedure has been developed for the analysis of ellipsometric data related to studies of thin film formations on metal surfaces. In processing the theoretical data necessary for these studies, the margin of accuracy attained was considered sufficient. In comparing test data with work done in these areas by the recognized efforts of R. J. Archer and F. L. McCrackin, the results differed by 0.02 percent. Since data to be processed are extensive and contain complex formulas requiring reduction to simplified interpretive solutions, accurate analyses are in demand. To date, results obtained with digital computers have offered considerable advantages over linear approximations or other solutions. A procedure was initiated utilizing a Fortran II language system and programing an ASI 210 digital computer to perform the evaluation operations. The limited memory size of the available computer made it necessary to prepare the program, or sequence of instructions, in a series of four functional units or "links." Author (NSA)

N67-22400# RAND Corp., Santa Monica, Calif.
JOSS: ARITHMETIC AND FUNCTION EVALUATION ROUTINES
I. D. Greenwald Sep. 1966 48 p refs
(Contract AF 49(638)-1700)
(RM-5028-PR; AD-640266) CFSTI: HC $3.00/MF $0.65

A description is given of the programming of arithmetic and function evaluation routines for JOSS from a programmers point of view. JOSS functions are divided into three groups: arithmetic operations (including exponential and square root), elementary transcendental functions, and number dissection functions. The four arithmetic operations (add, subtract, multiply, divide) and square root treat the operands as exact nine-digit numbers and produce true results rounded to nine digits. Descriptions of the arithmetic routines are presented in gross verbal flow-charts, amplified by commentaries. The discussion of the transcendental functions emphasizes the analysis done to achieve almost nine-significant-digit accuracy in the results and shows how special cases are handled to hit certain magic values on the nose. Program flows of the number dissection functions demonstrate how a sophisticated tool may be supplied to the user with trivial expenditure of programming effort. Author (TAB)

N67-22418# Joint Publications Research Service, Washington, D. C.
AN ALGORITHM FOR THE CONSTRUCTION OF THE SPATIAL DESCRIPTION OF A BODY GIVEN BY PROJECTIONS
Kh. I. Tani In its Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 187-194 *ref* (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

An algorithm is proposed for construction on a computer of a spatial description of bodies uniquely given by three projections. The formal descriptions of the figure and the body are presented in the form of graphs and matrices of metric characteristics. The spatial description is obtained by means of transformations of the graphs and simple calculations. The description obtained will be used for further processing, for example, for recognition of the geometric image of the body. Author

N67-22426* Planning Research Corp., Washington, D. C.
TAG USER'S MANUAL
Kenneth O. King, Kenneth Gillett, and William H. Libaw 22 Jan. 1967 p 147 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-83397; PRC-R-937) CSCL 09B

The TAG User's Manual provides a detailed description of the procedures for using the Transient Analysis Generator program developed at the Jet Propulsion Laboratory of the California Institute of Technology. The program provides the electrical engineering staff with a tool for performing transient analysis of large linear and nonlinear networks. Author

N67-22459# International Business Machines Corp., Bethesda, Md.
AN ANALYSIS OF INTERPRETER-COMPUTER REPORTING TECHNIQUES
Robert T. Root (Army Personnel Res. Office), Douglas Waugh, Kyra Hewitt, and James Donoghue Washington, Army Personnel Res. Office, Jun. 1966 125 p refs
(Contract DA-49-092-ARO-41)
(TRN-170; AD-645293) CFSTI: HC $3.00/MF $0.65

A study was made to identify and analyze factors in image interpreter-computer communication and to evaluate, through experimentation, reporting techniques selected as most useful for a computer-based tactical image interpretation facility. Sixteen raters made the required judgments for four separate reporting functions involving interpreter-computer interaction: (1) input of flight plan and mission data, (2) input of queries for retrieval of reference information, (3) Hot Report generation, and (4) Immediate Report generation. A survey of present Army reporting requirements indicated that while there is general agreement on the different types of reports required, there is no clear operational statement of reporting requirements for Hot and Immediate reporting that is consistently followed in the field. Analysis of reporting requirements for infrared and radar sensors indicated that words having unique meanings for these sensors must be added to the permissible reporting vocabulary. Also, report content must include the capability for providing alternative or additional information on characteristics of these sensors. Author (TAB)

N67-22592# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A RANDOM NUMBER GENERATOR
I. V. Yeremenko and A. N. Sverdlik 2 Sep. 1966 2 p Transl. into ENGLISH from Russian Patent No. 168545 (Appl. No. 863571/26-24, 30 Oct. 1963) p 1-2
(FTD-HT-66-90; AD-645823) CFSTI: HC $3.00/MF $0.65

The object of the invention is a random number generator, which contains a random pulse generator, a time pulse generator, shapers, a counter, a storage register for a number with equiprobable binary digits and a probability register-stabilizer, is different in that, to obtain binary numbers with the probability of the appearance of ones in them calculated by a decreasing geometric progression, the outputs of the storage register for equiprobable numbers are connected with multi-input coincidence circuits with one of the inputs of these circuits connected to the corresponding triggers of the probability register-stabilizer and the outputs of these circuits connected by a common collecting circuit that is connected with the output rectifier. Author (TAB)

N67-22586# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF LEARNING PROCESSES IN A COGNITIVE SYSTEM WITH ONE POSITIVE FEEDBACK
I. K. Parra 29 Jul. 1966 20 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 5, 1963 p 58–68
(FTD-TT-65-1850; AD-645821) CFSTI: HC $3.00/MF $0.65

A description of a self-organized system with positive feedback is presented. Results are given of investigating control methods by the order of self-teaching groups in the Alfa system with one positive feedback. Methods of learning and self-teaching of groups of association cells of the system are discussed. It is shown that for a system with one positive feedback, the selection of signs for recognition of the given group of forms should be realized not only for usefulness and stability, but also for the sequence of signs or for the resolving power of the system for each two forms. In order that the group of association cells of the Alfa system could relearn on any of the given forms, it is necessary that the minimum resolving power of the system be no less than unity at any given indicator adjustment of maximum voltage (IBN). Furthermore, it is necessary that the resolving power of each two forms differ at least by unity. The necessary minimum number of signs for the possibility of teaching and reteaching in the system is determined and it is shown that an increase in the number of positive feedbacks improves the selforganizing process in the system. Author (TAB)

N67-22599# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A GRAPHIC DATA TRANSFORMING INSTALLATION FOR INTRODUCTION INTO AN ELECTRONIC DIGITAL COMPUTER
S. A. Aleskerov and T. A. Aliyev 29 Jul. 1966 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat i. Tekhn. Nauk (Baku), no. 1, 1964 p 43–48
(FTD-TT-65-1992; AD-645822) CFSTI: HC $3.00/MF $0.65

A device is proposed for the introduction of graphs on paper tapes of any arbitrary width into the ETSVM in which the transformation of graphs is conducted by the method of transverse approximation. For the approximation of graphs is used a series of sensitive elements - CHE, situated on one straight line called sensitive line-approximator. In dependence upon the content of computer S-chi at each given time moment one of the CHE will have a high level-questioned. With this are determined the abscissas of the point of graph t sub i in form of a corresponding memory address of the machine. TAB

N67-22611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DATA-OUTPUT UNIT FOR A TYPE AI-50 MULTICHANNEL ANALYZER WITH A DYNAMIC DELAY-LINE MEMORY
I. I. Rogushin, K. F. Kuznetsov, and A. I. Kozyr 14 Jul. 1966 12 p ref Transl. into ENGLISH from Tr., Pyatoy Nauchn.-Tekhn. Konf. po Yadernoy Radioelektr. (USSR), v. 4, 1963 p 94–100
(FTD-TT-65-1092; TT-67-60507; AD-645841) CFSTI: HC $3.00/MF $0.65

A data-output unit is described which converts the sequential binary code of the number into a decimal code. TAB

N67-22614# Burroughs Corp., Paoli, Pa. Defense, Space and Special Systems Group.
DETECTION OF IMPLICIT COMPUTATIONAL PARALLELISM FROM INPUT–OUTPUT SETS Quarterly Report, 15 Jul.–15 Oct. 1966
Harvey W. Bingham, David A. Fisher, and Warren L. Semon Ft. Monmouth, N. J., Army Electron. Command, Dec. 1966 34 p refs
(Contract DA-28-043-AMC-02463(E))
(ECOM-02463-1; TR-66-4; AD-645120) CFSTI: HC $3.00/MF $0.65

This is the first report of an investigation designed to show how the implicit parallelism in programs written in present programming languages can be recognized and exploited by computers with highly parallel machine organizations. A language-independent recognition algorithm is developed. A program is treated as a partially ordered set of processes. A process is a transformation of an input set into an output set. The algorithm represents a method for converting the given ordering relation among processes in any given program into the essential ordering relation. Unnecessary serial ordering imposed by present programming languages is eliminated. The essential ordering is recognized by comparing inputs to processes with outputs of selected prior processes. The number of comparisons is the minimum necessary to detect the essential ordering. The algorithm is explained in detail and the equivalent graphical operations are described. Program loops and conditionals can be analyzed within the framework of the algorithm. Process inputs and outputs are related to memory and input-output devices. Various levels of partitioning a program into processes are discussed. Author (TAB)

N67-22632*# Bell Telephone Labs., Inc., North Andover, Mass.
OPTIMIZATION WITH COMPUTERS
William G. Scheerer *In* NASA. Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 75–82 refs (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65

Optimization algorithms designed and tested, are discussed. Each possesses particular advantages and disadvantages. Search techniques such as grid, random, and pattern search and the simplex algorithm are less affected by certain function anomalies than slope-following methods such as steepest descent, gradient partan, Fletcher–Powell and generalized Newton–Raphson. Steepest descent and gradient partan usually work with a poor initial estimate of the solution, while the generalized Newton–Raphson approach is efficient near the optimum, but may diverge elsewhere. The Fletcher–Powell technique utilizes both first and second derivative information, and is quite often the most efficient. Author

N67-22666*# Massachusetts Inst. of Tech., Cambridge.
COMPUTATION RESEARCH
Martha M. Pennell, Heather S. Davis, Gail M. Prater, Joan Harwitt, Elaine C. Isaacs et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 349–361 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Studies in programming and other computer-oriented services are briefly outlined. The revision of the basic computer indexing program for the needs of a small research group is reviewed. A method for finding roots of an analytic function and a root-finding subroutine using Muller's method are described. Continued work in linearizing the roots of a polynomial using the least squares method is reported. The development of a series of private user files for private libraries is mentioned. N.E.N.

N67-22673# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Aug.–31 Oct. 1966
Alfred E. Brain, Peter E. Hart, and John H. Munson Dec. 1966 33 p
(Contract DA-28-043-AMC-01901(E))
(ECOM-01901-25; RCS-OSD-1366; Rept.-25; QR-3; AD-645996) CFSTI: HC $3.00/MF $0.65

The results of experiments on piecewise-linear learning machines with handprinted characters are reported. The data, as before, consisted of three 46-character FORTRAN alphabets from each of 18 writers. The results of Experiment 3, a nine-view experiment, were compared with seven, five, three, and one-view results on the same training and testing set. The test error rate on characters not included in the training set fell steadily from 42

percent with the single view to 24 percent when the category of the character was determined from nine views. Results are reported on the program, which includes both preprocessing and classification. It is based on contour following and the determination of features including connected subfigures, strokes, concavities, and enclosures. The particular problem treated is the separation of '6s' for 'Gs'. A method of using the 1024-image optical preprocessor for the preprocessing of speech waveforms is described and some of the considerations that govern its practical implementation are discussed. The method is based on the determination of the amplitude coefficients of a Fourier series. Author (TAB)

N67-22679# Naval Weapons Lab., Dahlgren, Va.
COMPUTER ASSISTED INSTRUCTION: A SELECTED BIBLIOGRAPHY AND KWIC INDEX
Gerald L. Engel Jan. 1967 86 p refs Supersedes NWL-K-49/66 (NWL-K-3/67; NWL-K-49/66; AD-645654) CFSTI: HC $3.00/MF $0.65

This technical memorandum supercedes Technical Memorandum No. K-49/66 (AD-638 892). All entries found in K-49/66 are in this memorandum together with references to one hundred additional articles and reports. This technical memorandum also provides an annotated bibliography, referenced by a Key Work In Context (KWIC) index to selected articles on Computer Assisted Instruction (CAI). Author (TAB)

N67-22694# Polytechnic Inst. of Brooklyn, N. Y. Electrical Engineering Dept.
SECONDARY STATE ASSIGNMENT AND DECOMPOSITION OF SEQUENTIAL MACHINES
Zvi Kohavi and Edward J. Smith Aug. 1966 93 p refs (Contract AF 49(638)-1402) (PIBMRI-1345-66; AFOSR-66-1762; AD-646015) CFSTI: HC $3.00/MF $0.65

In the first part of the paper a method is developed to obtain for any given machine M which is in reduced form and undecomposable an equivalent machine M which possesses a partition with substitution property or partition pairs. Therefore, a state assignment or assignments with reduced dependency exist for M. The method requires augmentation of the original machine M by a technique of state-splitting. It should be noted that the augmentation does not necessarily increase the complexity of the logic required for the implementation and, in fact, often reduces it. The problem of finding cascade decompositions for two or more reduced machines which have the same input, such that a common submachine may be factored out and serve as a predecessor machine feeding two or more successor machines is examined. Necessary and sufficient conditions under which it is possible to obtain decompositions which contain such a common submachine are developed. If the given machines do not satisfy these conditions, and a common submachine cannot be found, it is shown how one or both machines can be replaced by equivalent machines in such a way that some common submachine can be found. A systematic method has been developed for the determination of the common factor. The basic tool, in this study is the composite machine (CM) which is derived from the original machines. The properties of the CM are studied and the maximal common factor is obtained with a minimum of computation or manipulation. Author (TAB)

N67-22742*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA COMPRESSION USING BIT PLANE ENCODING
Morton Kanefsky (Yale Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 1–21 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

The data compression scheme known as bit-plane encoding, requiring temporary storage of a block of telemetry data in a buffer memory, is outlined. The procedure is to encode and transmit the binary data in each of the planes sequentially. An example shows the power of this technique, and it is clear that when the data contains a high degree of dependency the most significant or highest order bit planes should contain long runs of zeros or ones. Thus, these planes can be significantly compressed by some type of run-length encoding. Furthermore, efficient quantization (a form of compression) can be achieved by truncating the number of planes. R.U.

N67-22746*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COUNTING WITH MAXIMAL LENGTH SHIFT REGISTERS
R. Kahn (MIT) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 65–73 (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Theoretical equipment required for the logical design of a counter with maximal length shift registers, as well as an efficient decoding algorithm for determination of the order number of the state of the register are discussed. Equipment carried onboard satellites may often be reduced by a shift register in conjunction with a single modulo-two adder to form a counter. If the shift register is used for counting purposes, the count must be rendered after reading the shift register contents. At a ground station, this could be accomplished by simulating a similar register on a computer and running through its states until one is obtained which matches the state of the counter. However, a method using less computer time than a maximal length shift register would be more desirable. R.U.

N67-22750*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF A FORMAL LANGUAGE TO DESCRIBE ON-BOARD AND GROUND STATION DATA HANDLING AND PROCESSING OF SATELLITE EXPERIMENTS
F. M. Sobotkin (City Coll. of the City of New York) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 121–134 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

For application to on-board satellite telemetry systems, the orders of complexity of the complete description for each experiment and its data handling and processing requirements must be specified. The EGO (Eccentric Geophysical Observatory) satellite was used in experiments. An attempt was made to show the feasibility of a non-ambiguous description to convey details of specifications between experimenters, system designers, and programmers. R.U.

N67-22751*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPLICATION OF MIMIC LANGUAGE AT GSFC
Yaohan Chu *In its* 1966 Session of the Goddard Summer Workshop [1967] p 135–224 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

For solving differential equations and related computations in support of the NASA scientific program, a new programming language, called Mimic, is presented. The problem-oriented Mimic language is different from the algorithmic Fortran language. The learning time and relearning time are short, and the language is considered of value to scientists and engineers for use with a graphical terminal. R.U.

N67-22771*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA REDUCTION TECHNIQUES FOR SPECTRAL RADIANCE ANALYSIS
John Crowell *In its* 1966 Session of the Goddard Summer Workshop [1967] p 417–427 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Studies of the solar simulation used data reduction techniques in connection with the Perkin–Elmer Model 112-U monochromator. The data obtained from the monochromator consist of a drum count corresponding to the wavelength of the energy observed, the gain factor of the recording amplifier, and the amplitude of the output of the amplifier. Methods and accuracy of the integration method are outlined. There are two programs for the CDC-3100 computer in use which perform the above operation: the fixed point program, and the manual program. Magnetic tapes are printed for use with the digital plotter on line with a CDC-160A computer so that the normalized flux of the unknown can be plotted as a function of wavelength. R.Li.

N67-22843*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

REPORT ON DIGITAL COMPUTERS USED IN AUTOMATIC CHECKOUT

B. Funderbunk 16 Mar. 1967 158 p refs

(NASA-TM-X-53590) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Twelve computer systems used in various phases of space vehicle checkout are described. The systems are evaluated, and hardware and software theory are discussed. Also discussed are the networks, instrumentation, telemetry, and electrical test stations. L.S.

N67-22917# United Kingdom Atomic Energy Authority, Harwell (England).

DATA LOGGING BY SMALL COMPUTER

D. N. MacLennan 1966 28 p refs

(AERE-R-5306) HMSO: 4s

An experimental system is described in which a P.D.P-8 Computer is used to log the output data from four on-line thermocouples. The extension of the system to at least 150 thermocouples or other transducers is discussed. Author

N67-22948# Royal Aircraft Establishment, Farnborough (England).

USE OF POLYNOMIAL APPROXIMATIONS IN DIGITAL COMPUTERS FOR SOLUTION OF AIR DATA FORMULAE

M. R. Green and R. M. Horner Jul. 1966 31 p refs

(RAE-TR-66230) CFSTI: HC $3.00/MF $0.65

Investigation of the feasibility of using polynomial approximation techniques for the digital solution of air data formulae is discussed. Least square methods were used to obtain polynomial approximations to the air data formulae for height, Mach number, indicated airspeed and true airspeed, these approximations being suitable for evaluation using nested multiplication, which is compatible with digital computer techniques. The results indicate that this method of computation could form the basis for a digital air data computer. Author

N67-23002# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.

MODIFICATIONS TO GROD

D. S. Norton Sep. 1966 28 p refs

(AEEW-M-683) HMSO: 4s

The programme GROD, which has been described elsewhere, is written in S.2 Fortran for use on the IBM 7030 computer and SC4020 at Aldermaston, and is used to produce graphical representations of data in the Aldermaston and Winfrith Nuclear Data Library. Further use of the programme at Winfrith has resulted in the detection of several faults and has shown the need for some extensions. Details of the modifications are given in the report and a listing of the modified programme is appended. Author

N67-23135# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

LIST PROCESSING RESEARCH TECHNIQUES. Quarterly Report, 15 Jun.–14 Sep. 1966

John W. Carr, III, Harry J. Gray, Willard K. T. King, and Charles Kapps Sep. 1966 29 p refs

(Contract DA-28-043-AMC-02377(E))

(ECOM-02377-1; Rept.-67-11; QR-1; AD-645445) CFSTI: HC $3.00/MF $0.65

Discussion of software techniques for symbol data manipulation and of the study and development of new unconventional central processor organizations having push-down list memories as both auxiliary and/or memories. Author (TAB)

N67-23147# Naval Ordnance Lab., White Oak, Md.

REVISED ANTICOINCIDENCE-SHIELDED GAMMA-RAY SPECTROMETER DATA-PROCESSING PROGRAM

Albert E. Evans, James Durkin, and Charles Knadler 6 Oct. 1966 39 p refs

(NOLTR-66-195; AD-644896) CFSTI: HC $3.00/MF $0.65

A program is described which processes and plots data accumulated by an anticoincidence-shielded scintillation spectrometer. This program is similar to that described in AD-611 198, except that an error in some statistical uncertainty calculations has been corrected, provision has been made for the subtraction of a common background spectrum from a number of input spectra submitted at one time but as separate problems, and spectra are all plotted with a common energy scale to permit the accumulation of a library of easily usable standard spectra. Also, the plotting routine has been changed so that for each energy channel the number of counts and the uncertainty thereof are represented by a datum point and uncertainty bar rather than by three data points. Provision has also been made for automatic labeling of all graphs and for labeling of the vertical axes. Author (TAB)

N67-23170# Lincoln Lab., Mass. Inst. of Tech., Lexington.

FASTABUL (A FAST AUTOMATIC STATION BULLETIN PROGRAM)

Philip L. Fleck 6 Jan. 1967 17 p refs

(Contract AF 19(628)-5167; ARPA Order 512)

(TN-1967-3; ESD-TR-67-16; AD-646207) CFSTI: HC $3.00/MF $0.65

A real-time program for a digital computer is described which uses the sampled outputs of an array of 21 seismometers as input. These data are reduced and output as a typewritten list of the physical parameters of any event present in the original data. The physical parameters automatically listed are some of the standard items included in the international seismic bulletin (e.g., epicenter location, origin time and magnitude). Results of this automatic method are presented. Author (TAB)

N67-23230# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

PROGRAM AND INTERFACING FOR "ON-LINE" USE OF A PDP-1 COMPUTER FOR BUBBLE CHAMBER FILM

W. Metzger, A. C. Melissinos, J. Berlinghieri, and S. Phelps Aug. 1966 50 p refs

(Contract AT(30-1)-875)

(UR-875-167) CFSTI: HC $3.00/MF $0.65

The present operation of a PDP-1 computer on-line to two Vanguard measuring machines used to process bubble chamber film is discussed. The input/output hardware, the main program (EXPENSIVE 528), and the subroutines are described. NSA

N67-23266*# Sperry Rand Corp., Blue Bell, Pa.
DESIGN, DEVELOP AND FABRICATE A FEASIBILITY MODEL OF A FERRIMAGNETIC MEMORY USING AN OPTICAL ACCESSION SYSTEM FOR READ WRITE FUNCTIONS Final Report
Norman Goldberg 22 Nov. 1966 45 p refs
(Contract NAS8-20509)
(NASA-CR-83539) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Details are given on the development of a sample material and techniques of sample preparation required for a room-temperature magneto-optic memory; the study of the magnetic, optical, and thermal properties of the materials; and the design and fabrication of a magneto-optical unit for demonstrating packing density and to read and write cycle times. The storage element of the memory is a platelet of gadolinium iron garnet (GdIG) doped with aluminum so that the compensation temperature is approximately room temperature. The techniques of growing large flux-free GdIG with a compensation temperature of 25°F are described, as well as the method of preparing platelets of GdIG for use as memory elements. Faraday rotation and absorption measurements were made, and the optimum wavelength for the memory operation was determined. Finally, the feasibility of the system was demonstrated by the fabrication of a model. L.E.W.

N67-23269*# Maryland Univ., College Park. Dept. of Electrical Engineering.
BOOLEAN TRANSLATION OF THE SYMBOLIC DESIGN OF A DIGITAL COMPUTER
Bruce D. McCurdy (M.S. Thesis) Jan. 1967 106 p refs
(Grant NsG-398)
(NASA-CR-83542; TR-67-39) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Details are given on the development of a set of five computer programs, for use with the IBM 7090/7094 computer, to simulate and translate a chosen computer design in Chu's Computer Design Language (CDL) into boolean equations. The programs are written in the Michigan Algorithmic Decoder (MAD) programming language. The computer design is transcribed into a MAD program and is then expanded into a simulation program, which uses data as a sample test program encompassing the entire instruction repertoire of the designed computer and produces an octal output representing all register contents for each clock. The translation is accomplished by a set of four consecutive programs: a tabulation program, a truth table program, a boolean expression program, and a boolean equation program. The advantages and disadvantages of using MAD to simulate a CDL design are also delineated. Author

N67-23279*# Maryland Univ., College Park. Computer Science Center.
DIGITAL ANALOG SIMULATION TECHNIQUES
Yachan Chu 15 Feb. 1967 70 p refs
(Grant NsG-398)
(NASA-CR-83551; TR-67-40) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Some techniques in digital analog simulation are presented. There are two types of techniques: those developed for analog computers but which can also be applied to digital simulation, and those developed for digital analog simulation by provision in the simulation language and its compiler. The recent language Mimic is chosen to be used as the simulation language. Digital analog simulation techniques are shown by presenting the Mimic programs of several problems and their results. Six problems are chosen: (1) solution of a non-linear differential equation, (2) computation of a complex transcendental expression, (3) generation of Bessel functions of the first kind, (4) solution of a partial differential equation, (5) double integration of a function, and (6) simulation of a non-linear feedback control system. Author

N67-23303*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF COMPUTERS TO THE FORMULATION OF PROBLEMS IN CURVILINEAR COORDINATE SYSTEMS
James C. Howard Washington, NASA, Apr. 1967 52 p refs
(NASA-TN-D-3939) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A means is described of extending digital computers beyond the numerical data processing stage and reducing the need for human participation in the formulation of certain types of computer problems. By the use of tensor calculus and a computer language designed to facilitate the use of symbolic mathematical computation, a method has been devised whereby a digital computer can be used to do non-numeric work, i.e., symbolic algebraic manipulation and differentiation. To illustrate the techniques involved, a digital computer was used to derive the equations of motion of a point mass in a general orthogonal curvilinear coordinate system. Since this operation involves a formulation in terms of first- and second-order differential coefficients, it provides a good demonstration of a computer's capability to do non-numeric work and to assist in the formulation process which normally precedes the numerical data processing stage. This problem also illustrates the advantages of the mathematical techniques employed. The computer derives the equations of motion in any coordinate system. Results are presented for cylindrical polar, spherical polar, oblate spheroidal, and prolate spheroidal coordinate systems. Author

N67-23340* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIANA: A DIGITAL-ANALOG SIMULATION PROGRAM FOR THE IBM 1620 II COMPUTER
R. J. Mankovitz 1 Mar. 1967 65 p refs
(Contract NAS7-100)
(NASA-CR-81297; JPL-TR-32-1011, rev. I) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Diana is a block-oriented interpretive program which can be used to simulate physical systems by solving the simultaneous differential equations describing the systems. The program behaves much like an analog computer, with on-line control and input–output capabilities. Available Diana integration methods include: fifth-order Adams–Moulton, with adaptive step size; fixed-step Adams method; and Runge–Kutta–Gill method. Author

N67-23362# Radio Corp. of America, Princeton, N. J. RCA Labs.
LOGIC NETS, THEIR CHARACTERIZATION, RELIABILITY AND EFFICIENT SYNTHESIS Special Scientific Report No. 2, 1 Oct. 1965–30 Sep. 1966
K. R. Kaplan, C. V. Srinivasan, and R. O. Winder Oct. 1966 26 p refs
(Contract AF 19(628)-4789)
(AFCRL-66-808; AD-646059) CFSTI: HC $3.00/MF $0.65

The report consists of two parts. The first summarizes the features of a collection of subroutines written on a time-shared teletype-accessible computer to facilitate experimentation in the design of networks of threshold gates. The second summarizes initial plans for research in automated design aid systems for computer systems design; an overview of the problem is given. Author (TAB)

N67-23358# Air Force Cambridge Research Labs., Bedford, Mass.
A STUDY OF SHAPE RECOGNITION USING THE MEDIAL AXIS TRANSFORMATION
Otis Philbrick Nov. 1966 38 p refs *Its* Phys. Sci. Res. Papers No. 288
(AFCRL-66-759; AD-646258) CFSTI: HC $3.00/MF $0.65

The Medial Axis Transformation is a transformation by which shape description properties may be extracted from an arbitrary shape. The paper examines properties of the transformation as applied to shape recognition, and discusses how these properties

may best be used for this purpose. The transformation and its inverse transform have been simulated on a digital computer, and properties of the transformed shape have been examined with the use of the computer. Author (TAB)

N67-23389# General Electric Co., Syracuse, N. Y. Electronics Lab.
OPTICAL ANALOG MATRIX PROCESSOR Final Report, Jun. 1964–Jun. 1966
A. W. Edson and M. L. Noble Nov. 1966 154 p
(Contract AF 19(628)-4199)
(AFCRL-66-793; AD-646060) CFSTI: HC$3.00/MF$0.65

The report describes the design considerations of an optical processing system which can perform matrix transformations of large dimensional vectors at exceedingly wide processing bandwidths. Input vectors of wide bandwidth, up to 10 HMz are recorded on a surface deformable film. A unique optical system utilizes a photographic plate, bearing the matrix information, to permit the matrix transformation to proceed as a set of simultaneous parallel operations. The output vector may be scanned to form a temporal signal or the parallel output may be maintained for further processing. Selected portions of an experimental model were fabricated and tested. The results of this program are given and their influence on the overall system is evaluated. As a result of this program an improved version of the Optical Analog Matrix Processor has evolved. Recommendations are given for means to increase the processing rate, for vectors with several hundred coherent elements, from the general region of 100/sec by several orders of magnitude. Author (TAB)

N67-23420 Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.
THE USE OF THE STATISTICAL NATURE OF LANGUAGE IN MACHINE RECOGNITION
Yoshinori Uesaka and Soichiro Kuroki Dec. 1966 21 p refs
Its Serial No. 105

A method is presented which improves the ability and efficiency of a language recognition system, such as a printed-text recognizer or a phonetic typewriter, by using the redundancy of the human language. The validity of the method was confirmed experimentally with a 2000 work essay; the recognition rates were increased from the original rates of 38.8%, 56.3%, and 71.3%, to 67.2%, 85.4%, and 91.6% respectively. A.G.O.

N67-23421 Joint Publications Research Service, Washington, D. C.
THE TECHNOLOGY OF COMPUTER PRODUCTION
S. A. Meyorov 7 Feb. 1967 16 p refs Transl. into ENGLISH from the book "Tekhnologiya Proizvodstva Vychislitel'nykh Mashin" Moscow, Izd. Mashinostr., 1965
(JPRS-39826; TT-67-30474)

The foreword, chapter abstracts, and bibliography of a publication pertaining to computer technology for scientific research and economic planning are presented. Much of the book is devoted to examination of the production of specific elements, assemblies, and modules for small-dimension digital computers employing semiconductor and ferrite elements. S.P.

N67-23427 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPUTER TECHNOLOGY Surveys of Foreign Scientific and Technical Literature
Boris Doncov 30 Dec. 1966 61 p refs Compilation of Abstracts
(ATD-66-145)

Pertinent information included: a multichannel autocompensating multiplier/divider unit, analog-digital signal comparison circuit, use of digital logic elements in analog machines designed for solving boundary problems, EASP-S electronic random process analyzer, BESM-6 computer complex, memory units, long-time memory system, M-20 digital computer, system for information transfer between digital and analog computers, gathering primary video information with slow-scan TV facilities, singlechannel digital optimizer, information referral center, code converters, and relay-type contactless regulator. Author

N67-23457# Joint Publications Research Service, Washington, D. C.
ATTEMPTS TO FREE THE ORDINARY ENGINEER FROM THE NEED TO MASTER COMPUTER LANGUAGE
N. Kanivets 2 Feb. 1967 8 p Transl. into ENGLISH from Nauka i Tekhn. (Riga), no. 10, Oct. 1966 p 33–35
(JPRS-39741; TT-67-30389) CFSTI: HC$3.00/MF$0.65

The possibility of engaging digital computers to perform individual stages of operations in compiling programs is considered. Attempts to automate programming are described, and the problem of universal algorithm language is examined. The development of an individual algorithm language created for notation of algorithms to be carried out on a digital computer is described. Creation of algorithm languages and programming programs enables the digital computer to perform programming assignments. An example of a simple autocode program is presented to illustrate this capability. S.P.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-22176* Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
DESIGN OF MICROELECTRONIC CIRCUITS Final Report
Jan. 1967 54 p
(Contract NAS12-16)
(NASA-CR-80017) CFSTI: $3.00 CSCL 09A

The integrated circuit operational amplifier and the integrated analog switch circuit designed for deep space probe applications are described. The amplifier circuit, for achieving high voltage gain with low power dissipation, is basically a complementary differential amplifier with an n–p–n differential input stage followed by a p–n–p differential second stage. The switch consists of a driver circuit and a field effect transistor which is the driven element. Four switches, packaged together in a fourteen lead flat package, operate independently with one pair having a common output lead. Performance characteristics and schematics of the amplifier and switch circuits are included. Specific applications are described for servo stabilization network, zero crossing detector, sample and hold circuit, and sample filter circuit. N.E.N.

N67-22181# Israel Program for Scientific Translations, Ltd., Jerusalem.
FIVE HUNDRED KV LONG-DISTANCE ELECTRIC TRANSMISSION
A. M. Nekrasov and S. S. Rokotyan (ed.) 1966 891 p refs Transl. into ENGLISH of the book "Dal'nie Elektroperedachi 500 kV" Moscow, Izdatel'stvo Energiya, 1964
CFSTI: HC$3.00/MF$0.65

Articles are presented which pertain to the design, manufacture, and maintenance of the equipment and structures used in constructing the 500 kV long distance electric transmission lines. For individual titles, See N67-22182 through N67-22210.

N67-22182# Israel Program for Scientific Translations, Ltd., Jerusalem.
SUMMARY OF THE CURRENT POSITION AND REVIEW OF TRENDS IN EXTRA-HIGH-VOLTAGE TRANSMISSION LINES
A. M. Nekrasov *In its* 500 kV Long-Distance Electric Transmission 1966 p 1–9 (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The centralization of electric power production by the development and unification of power systems is shown to be the most effective and economically desirable method of ensuring adequate electric power for consumers. This method permits a better utilization of thermal and hydraulic energy sources, more rational use of power, a reduction in the capital cost of the power plant, and a quicker commissioning of equipment. Information gained from the construction and operation of high voltage transmission lines as well as from research is discussed. R.N.A.

N67-22183# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE DESIGN OF 500 KV TRANSMISSION LINES
S. S. Rokotyan *In its* 500 Kv Long-Distance Electric Transmission 1966 p 10–32 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Various factors which must be considered in the design of 500 kV transmission lines are discussed. These include decisions concerning the number of circuits, conductor size, the use of bundle conductors, shunt reactors and their location, the location and connection of series compensating capacitors, the use of synchronous condensers at intermediate substations, and the choice of interlinked or non-interlinked transmission lines. R.N.A.

N67-22184# Israel Program for Scientific Translations, Ltd., Jerusalem.
METHODS OF RAISING THE POWER LOADING OF 500 kV LINES
S. I. Azar'ev *In its* 500 kV Long-Distance Electric Transmission 1966 p 33–49 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The various methods of increasing the power loading of transmission lines are shown to be concerned either with improvements in the design and utilization of transmission line elements, or with the installation of equipment to meet various demands after commissioning of the lines. The methods discussed include electrical and mechanical braking of generators, raising the mechanical inertia and reducing the reactance of generators, the automatic disconnection of generators to improve stability, grounding of transformer neutrals through reactors or resistors, the regulation of prime movers, fixing the transmission voltage of an optimum level, transmission line operation with a negative potential drop, selecting the number of transmission line circuits and routes, series capacitor compensation of line reactance with or without automatic boosting of capacitor banks, the installation of synchronous condensers at intermediate stations, the use of controlled reactor-transformers, the installation of capacitor banks at intermediate and receiving substations, and the application of high speed large range excitation of synchronous machines and high speed excitation regulators. R.N.A.

N67-22185# Israel Program for Scientific Translations, Ltd., Jerusalem.
INVESTIGATION OF THE STABILITY OF 500 kV TRANSMISSION LINES USING LABORATORY MODELS
E. A. Marchenko, Yu. D. Sadovskii, and S. A. Sovalov *In its* 500 kV Long-Distance Electric Transmission 1966 p 50–65 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Investigations of transmission line stabilities are described which were conducted using electrical dynamic models. The models were adjusted using data obtained from tests made on actual systems. The investigations confirmed that during unfavorable operating conditions, a stability disturbance on one transmission line may act via another transmission line to create a danger to the synchronism of powerful hydroelectric stations. The effect of emergency conditions on one line on the performance of another depends largely on the nature of the connection to the receiving system. The danger of mutual interaction increases with a strengthening of the coupling between transmission lines at the receiving system lines using step-down transformers with direct 500 kV connections). One basic means of raising the power supply reliability is to use all available methods of preventing stability disturbances on transmission lines. Special attention must be given to the method of automatically controlling the transient stability of transmission lines. The use of electrical dynamic models is shown to be an effective method in studying the mutual interaction of transmission lines. R.N.A.

N67-22186# Israel Program for Scientific Translations, Ltd., Jerusalem.
OPERATIONAL REGIMES AND STABILITY OF THE 500 kV VOLGOGRAD–MOSCOW TRANSMISSION LINE
S. A. Sovalov *In its* 500 kV Long-Distance Electric Transmission 1966 p 66–93 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Various design, test, and operational aspects during the setup of the Volgogard–Moscow transmission line are described. Included are discussions of the circuit arrangement during the running-in period, the period of single circuit operation, testing the current dependent high speed excitation regulators of the Volgogard station generators, the single circuit line with intermediate connections, installation tests on frequency dependent excitation regulators, an experimental disconnection of the generating capacity, tests of the steady state stability with current dependent generator excitation and with frequency dependent excitation regulation, an analysis of the test results, the introduction of the second circuit of the Volgogard–Lipetsk section of the transmission line, the change-over to 500 kV of the receiving end of the Volgogard–Moscow transmission line, and the introduction of the second circuit of the Lipetsk–Moscow section which marked the completion of the Volgogard–Moscow transmission line. R.N.A.

N67-22187# Israel Program for Scientific Translations, Ltd., Jerusalem.
OPERATION AND STABILITY OF THE KUIBYSHEV-URAL TRANSMISSION LINE
S. A. Sovalov *In its* 500 kV Long-Distance Electric Transmission 1966 p 94–119 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The Kuibyshev-Ural transmission line was orginally designed to operate at a voltage of 400 kV. Following the decision to adopt 500 kV for this line, it was suggested that operation be started at 400 kV, and that the line be subsequently changed over to 500 kV. Bugul'ma and Ufa connect the transmission line to the Tatar and Bashkir power systems; Zlatoust, Chelyabinsk, and Sverdlovsk substations connect the line with the Ural Power System. The transmission line is a powerful intersystem link and an important part of the European–U.S.S.R. power system. The Kuibyshev–Ural transmission line was commissioned in sections, the first section being Kuibyshev–Bugul'ma and the last Zlatoust–Sverdlovsk. The schemes put forward for operating line during the intermediate stages of its utilization differed considerably, both with regard to the conditions applying to the export of power from the HEP, and the role of the transmission line as an

intersystem link. The basic data regarding the performance and stability of the transmission line are presented. These were derived from an analysis of operating experience and from system tests.
Author

N67-22188# Israel Program for Scientific Translations, Ltd., Jerusalem.
OPERATING CONDITIONS OF 500 KV TRANSMISSION LINES
A. I. Gershengorn and N. N. Sokolov *In its* 500 kV Long-Distance Electric Transmission 1966 p 120–138 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The main changes in the operation of extra high voltage transmission lines resulting from a change-over from 400 to 500 kV are discussed. Included are analyses of substitution circuits, changes in line load, no-load operation, high load operation, rating and location of shunt reactors, and voltage regulation of the 500 kV transmission lines.
R.N.A.

N67-22189# Israel Program for Scientific Translations, Ltd., Jerusalem.
OPERATING FEATURES OF 500 KV POWER SYSTEMS WITH D–C INTERTIES
G. I. Polyak *In its* 500 kV Long-Distance Electric Transmission 1966 p 139–145 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The results of research on dc transmission relating to normal operation and stability are presented. Also included is a brief description of the analytical methods used to investigate power systems containing dc transmission lines, in particular, those for examining the operating conditions and the mutual influence of a three-phase system and a dc transmission line.
R.N.A.

N67-22191# Israel Program for Scientific Translations, Ltd., Jerusalem.
CORONA AND THE CHOICE OF CONDUCTORS FOR A 500 KV TRANSMISSION LINE
B. B. Burgsdorf, N. P. Emel'yanov, and E. N. Zhuravlev *In its* 500 kV Long-Distance Electric Transmission 1966 p 152–168 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The differences in corona loss and radio interference levels encountered in 500 kV transmission lines at different times with identical weather conditions are discussed along with the selection of conductors. The methods used to investigate this problem are shown to be inadequate and merely establish a limiting permissible value for interference levels without reference to when such interference arises or to the degree by which the norm is exceeded. The interference level of a high voltage line in unfavorable meteorological conditions is, in fact, higher than the norm, if only for a short time. However, the experience gained in operating such lines has shown that these increases in level do not cause any dangerous consequences. It follows that the evaluation of interference, and the establishment of normal values, must be based on probability and statistical methods. It appears that radio interference problems can be solved more economically by improving radio reception rather than by reducing interference. Since interference attenuates rapidly with distance, one method would be to use appropriate outside antennas.
R.N.A.

N67-22193# Israel Program for Scientific Translations, Ltd., Jerusalem.
MEASUREMENTS OF CORONA LOSSES ON THE NIIPT EXPERIMENTAL LINE WITH VARIOUS CONDUCTORS
L. V. Egorova, N. S. Kiselova, N. N. Tikhodeev, and A. A. Filippov *In its* 500 kV Long-Distance Electric Transmission 1966 p 189–202 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Experimental results of corona losses on high voltage transmission lines using single and bundle conductors are reviewed. A new coordinate expression for corona losses is given. In arriving at the expression, statistical methods were used to compare expressions put forward in various coordinates. Problems encountered in the methods of generalizing the experimental data are discussed. The results of generalizing the experimental data on corona losses for five types of weather are presented.
R.N.A.

N67-22194# Israel Program for Scientific Translations, Ltd., Jerusalem.
MINIMUM CLEARANCES FOR 500 kV OVERHEAD LINES AND SUBSTATIONS
N. N. Tikhodeev *In its* 500 kV Long-Distance Electric Transmission 1966 p 203–208 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

To facilitate the design and construction of 500 kV transmission lines, an investigation was made of the dielectric strength of air gaps. The object was to determine the size of minimum permissible clearances in air, taking into account the internal overvoltages which would appear across these clearances, the dispersion of the values of the breakdown voltages, and the likely decrease in breakdown voltage caused by unfavorable meteorological conditions. The tests were conducted using a voltage of 1000 kV to fix clearances to ground objects, and with 1500 kV for interphase clearance. The tests, using electrode configurations similar to those found in practice, made it possible to fix minimum clearances for 500 kV overhead lines and substations with regard to overvoltages. These clearances are tabulated.
R.N.A.

N67-22195# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE ELECTRICAL CHARACTERISTICS OF THE INSULATION OF 500 KV LINES
E. V. Kalinin, S. D. Merkhalev, N. M. Solomonov, and N. N. Eikhodeev *In its* 500 kV Long-Distance Electric Transmission 1966 p 209–217 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

In connection with the development of 500 kV transmission lines, electrical tests were made on insulator strings to determine their characteristics. Because line insulation is subject to internal and external overvoltages and the working voltage, studies were made of wet and dry flashover voltage, the long time withstand voltage of wet dirty insulator strings, and impulse flashover voltage. Protective devices were also investigated. The tests were conducted under both laboratory and field conditions using P-type and alkali glass insulators. The results are tabulated and discussed.
R.N.A.

N67-22196# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTERNAL OVERVOLTAGES ON 500 KV TRANSMISSION LINES AND PROTECTION AGAINST THEM
Yu. I. Lyskov and N. N. Sokolov *In its* 500 kV Long-Distance Electric Transmission 1966 p 218–252 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

A lengthy discussion is presented on the basic forms of internal overvoltages on 500 kV transmission lines, the means of limiting internal overvoltages, an estimation of the likely magnitude of internal overvoltages, the choice of systems to protect against internal overvoltages including an example of one such system being used, and prospects of lowering the design limit on internal overvoltages.
R.N.A.

N67-22197# Israel Program for Scientific Translations, Ltd., Jerusalem.
LIGHTNING ARRESTERS FOR 500 KV

V. P. Savel'ev and A. I. Bronfman *In its* 500 kV Long-Distance Electric Transmission 1966 p 253–262 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The electrical characteristics of various types of spark gap lightning arresters, used on 500 kV ac transmission lines to limit internal and external overvoltages, and their ceramic resistance elements are described. R.N.A.

N67-22198# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE DISCHARGE CHARACTERISTICS OF 500 kV MAGNETIC-VALVE ARRESTERS

A. I. Bronfman, E. V. Kalinin, and N. M. Solomonov *In its* 500 kV Long-Distance Electric Transmission 1966 p 263–272 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The two types of magnetic valve arresters used in 500 kV networks are 1) a lightning type, for protection against lightning and some kinds of switching overvoltage, and 2) a combined type, for protection against external and internal voltages. An account is given of an investigation of the discharge characteristics of both types of arresters. Results show that the discharge characteristics and the external insulation of 500 kV arresters satisfy the technical specifications for this equipment at a frequency of 50 kps, and also when subjected to impulse voltages. When the combined arrester is actuated by switching surges, no faulty flashover of spark gap elements occurs and the arrester functions properly. The combined arrester changes over from the switching mode to the lightning mode at a discharge voltage of 1250 to 1280 kV. The coordinated operation of both types of arresters, connected to the same buses, is sufficiently reliable with industrial frequency covervoltages. With overvoltage factors of 2.35 to 2.55, the probability of the lightning arrester discharging does not exceed 6.25%, while the probability of its damage is even less. R.N.A.

N67-22199# Israel Program for Scientific Translations, Ltd., Jerusalem.

FIVE HUNDRED kV OVERHEAD TRANSMISSION LINES

L. E. Levin and S. S. Rokotyan *In its* 500 kV Long-Distance Electric Transmission 1966 p 273–307 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Basic design data and principles for constructing 500 kV transmission lines are presented. Available literature on constructing high voltage lines is reviewed. Information is included on climatic considerations in determining clearances between conductors, insulator strings, and line supports; line support loads; rated strength of materials; and steel and reinforced concrete supports and foundations. R.N.A.

N67-22200# Israel Program for Scientific Translations, Ltd., Jerusalem.

ALUMINUM/STEEL RATIOS FOR LINE CONDUCTORS

A. A. Glazunov and P. E. Sandler *In its* 500 kV Long-Distance Electric Transmission 1966 p 308–324 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Results are presented of an investigation which was conducted to determine the optimum ratio of aluminum to steel in the steel reinforced aluminum cables used in high voltage transmission line conductors. Consideration was given to the performance of conductors in operation, their overload capacity, and transmission line economic indexes. Conductors with aluminum to steel ratios of 3 to 10 and with aluminum sections of 70, 150, 300, 480, and 712 mm^2 were used for the conditions applying in four icing zones. R.N.A.

N67-22203# Israel Program for Scientific Translations, Ltd., Jerusalem.

DISTRIBUTION EQUIPMENT FOR 500 kV THERMAL POWER PLANTS

K. K. Levitskii *In its* 500 kV Long-Distance Electric Transmission 1966 p 363–371 (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Descriptions are presented of the substation circuits and equipment layouts of 500 kV thermal power plants, the installation of transformers outside machine halls and in switchyards, and the layout and construction of 500 kV switchyards. R.N.A.

N67-22204# Israel Program for Scientific Translations, Ltd., Jerusalem.

FIVE HUNDRED kV SWITCHGEAR FOR LARGE HYDROELECTRIC PLANTS

B. S. Uspenskii *In its* 500 kV Long-Distance Electric Transmission 1966 p 372–390 (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The design of switchgear for hydroelectric plants (HEP) with capacities greater than 1000 MW is examined. The discussion covers basic factors affecting the main electrical connection schemes of HEPs; general schemes of electrical connection for very large HEPs; descriptions of the HEPs at Bratsk, Nurek, Krasnoyarsk, Ingur, Saratov, and Votkinsk; the design of 500 kV switchyards for HEPs; and switchyard problems involving control and the location of protective relay panels and storage batteries. R.N.A.

N67-22205# Israel Program for Scientific Translations, Ltd., Jerusalem.

FIVE HUNDRED kV STEP-DOWN SUBSTATIONS

K. K. Levitskii and Yu. A. Yakub *In its* 500 kV Long-Distance Electric Transmission 1966 p 391–415 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Basic problems encountered in the construction and operation of 500 kV step-down substations are discussed. Consideration is given to connection schemes of distribution equipment; 500 kV switchyard equipment including power transformers, voltage transformers, and arresters; and equipment for grounding and protecting against overvoltages. Also covered are insulation and clearances for 500 kV distribution equipment; 500 kV switchyard structures and buses; internal load of substations; direct current supply; compressor installation; synchronous condensers; shunt capacitor banks; control equipment building; workshops for the assembly, inspection, and repair of power transformers; and shunt reactors. R.N.A.

N67-22206# Israel Program for Scientific Translations, Ltd., Jerusalem.

FIVE HUNDRED kV SERIES-CAPACITOR INSTALLATIONS

Yu. A. Yakub *In its* 500 kV Long-Distance Electric Transmission 1966 p 416–430 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Calculations have shown that the capacity of a double circuit transmission line from the Bratsk hydroelectric plant to Irkutsk (a distance of 600 km), with one switching point in mid-line, is only 1150 MW. The most economical method of raising the loading to 1600 MW was found to be capacitative compensation of the reactance of the line. Design and construction details of the series-capacitor installation for the Bratsk–Irkutsk line are described. The experience acquired in operating the series-capacitor installation on the Kuibyshev–Moscow line at a voltage of 500 kV was used. The operation of this installation is described and an economic comparison between the two installations is made. R.N.A.

N67-22209# Israel Program for Scientific Translations, Ltd., Jerusalem.

FIVE HUNDRED kV POWER TRANSFORMERS

L. N. Shifrin *In its* 500 kV Long-Distance Electric Transmission 1966 p 449–475 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Design and construction details of several types of 500 kV step-up transformers and autotransformers are reviewed. Tables listing these transformers and their characteristics are included. All the transformers, irrespective of their capacity, are transported in their own hermatically sealed tanks under a positive pressure of nitrogen or dry air to prevent contact of the removable part of the transformer with the atmosphere and thus avoid absorption of moisture. Development prospects for the transformers in the immediate future are discussed. R.N.A.

N67-22210# Israel Program for Scientific Translations, Ltd., Jerusalem.
RELAY PROTECTION AND EMERGENCY AUTOMATIC EQUIPMENT FOR 500 kV TRANSMISSION LINES
V. M. Ermolenko and A. M. Fedoseev *In its* 500 kV Long-Distance Electric Transmission 1966 p 502–558 refs (See N67-22181 11-09) CFSTI: HC$3.00/MF$0.65

The wide use being made of various types of automatic equipment for coping with emergency conditions in the operation of high voltage transmission lines is discussed. In combination with relay protection, this equipment results in better operation and reliability of transmission lines. The requirements for this automatic equipment are discussed along with problems, performance, and future trends. R.N.A.

N67-22448# Institute of Modern Languages, Inc., Washington, D. C.
INTERFERENCE PHOTOCATHODES OF INCREASED YIELD WITH FREELY SELECTIVE SPECTRA MAXIMUM [INTERFERENZ-PHOTOKATHODEN ERHOEHTER AUSBEUTE MIT FREI WAEHLBAREM SPEKTRALEM MAXIMUM]
K. Deutscher Dec. 1966 28 p Transl. into ENGLISH from Z. Physik (Berlin), v. 151, 1958 p 537–555
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1879-66; TT-67-60318; AD-644149) CFSTI: HC $3.00/MF$0.65

The partially permeable metal film of an interference reflector is designed as photoelectrically sensitive film. The reflectivity of the interference photocathode then is zero and/or very low for radiation of a freely selective given wavelength. The greater part of the irradiated luminosity is absorbed in the photofilm. As contrasted with the customary photoelectric monolayer, absorption was increased by a factor of three and electron emission, however, by a factor of nine. This surprising increase of yield is interpreted by the fact that it is possible, in the interference photocathode, to almost completely absorb the luminous energy in the film lamellae near the surface. By reason of the short range of the photoelectrons in the metal, only the electrons excited in the film lamellae close to the surface have a high probability of emission. The increase of yield over the customary photofilm consequently has as basis that the irradiated luminous energy is absorbed almost completely and the layers have a high effective quantum yield due to the efficient absorption gradient. Author (TAB)

N67-22450# Army Electronics Lab., Fort Monmouth, N. J.
MODULATOR PERFORMANCE OF ONE-KILOVOLT THYRISTORS
Thomas O. Krueger and Frederick A. Vorwerk Nov. 1966 19 p ref
(ECOM-2771; AD-643402) CFSTI: HC$3.00/MF$0.65

Two solid state thyristors have been developed for fast switching applications. One is a gate activated switch rated at 1000 V maximum anode voltage and 100 A peak anode current; the other is a two-terminal four layer switch of the same ratings for use in series with the gate activated switch as a slave switch. Performance of the gated switch was measured for different pulse widths, amplitudes, pulse repetition rates, and circuit impedances. In these tests the pulse width was varied from 0.1 to 1.0 microsecond, the circuit impedance from 10 to 50 ohms, and the pulse repetition rate from 1000 to 10,000 pps. Measurements were made of current rise time, fall of anode potential, maximum operating voltage, and dissipation as a function of operating parameters. Some tests were also conducted on series operation of the two-terminal device with the gated thyristor. The design of the devices and their pertinent characteristics are discussed in relation to their performance in modulator circuits. Author (TAB)

N67-22541# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
TECHNIQUE FOR FABRICATION OF Al–Al_2O_3–Pb SUPERCONDUCTING TUNNEL DIODES
Jose H. Silva, Jr. Nov. 1966 16 p refs *Its* Instrumentation Papers No. 121
(AFCRL-66-750; AD-645750) CFSTI: HC $3.00/MF $0.65

The report describes an improved method of growing Al - Al2O3 - Pb superconducting tunnel diodes. Since the resistance of the diode is dependent upon the thickness of the oxide layer, this layer must be carefully controlled in order to fabricate diodes of the desired resistance in a reproducible manner. The key to this method is a substrate holder which allows the entire process to be completed under vacuum. Author (TAB)

N67-22560# Litton Industries, San Carlos, Calif. Electron Tube Div.
Ku-BAND PULSED MAGNETRON Final Report, 1 May–30 Nov. 1966
G. Thornber Dec. 1966 73 p refs
(Contract DA-28-043-AMC-01317(E))
(ECOM-01317-F; Rept.-1; AD-645306) CFSTI: HC $3.00/MF $0.65

The Litton Industries type L-3496 magnetron, Ku-band, 1 kw peak, .001 duty, tunable, 16,000 to 16,500 Mc, was redesigned to eliminate a discontinuity in the rf pulse which occurred near the operating point. Complete electrical design calculations are given. A series of tubes was built and improvements beyond the design calculations were introduced in the areas of anode impedance, magnetic field shape, cathode structure and output coupling. Performance results of 29 tubes and life test results of six tubes are given. The rf pulse discontinuity problem was eliminated and the useful life of the L-3496 magnetron was increased from tens of hours to hundreds of hours. The improved magnetron is identified as type L-3496A. Recommendations are made to incorporate mechanical improvements necessary for consistent high yield fabrication. Author (TAB)

N67-22571# New York Univ., N. Y. Lab. for Electroscience Research.
MODES IN PERIODIC STRUCTURES Final Report, 1 Jun. 1963–30 Nov. 1966
Don J. R. Stock Dec. 1966 11 p refs
(Grant DA-ARO(D)-31-124-G462)
(AROD-4155-4; AD-645934) CFSTI: HC $3.00/MF $0.65

The objective of the research project herein reported was to study properties of those periodic waveguides which are uniform waveguides loaded by planar obstacles. The study included consideration of the fields of the guide, the propagation constants of the guide, and the operators associated with the guide fields. Author (TAB)

N67-22572# General Electric Co., Irmo, S. C. Electronic Specialty Capacitor Business Section.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF HERMETICALLY SEALED TANTALUM FOIL CAPACITORS Quarterly Report, 20 Sep.–20 Dec. 1966

R. M. Trewhella 20 Dec. 1966 17 p
(Contract DA-36-039-AMC-06169(E))
(QR-5; AD-646038) CFSTI: HC $3.00/MF $0.65

The accomplishments during the fifth reporting period were the manufacturing completion of the test capacitors in the production run. The start-up of the reliability proof test was completed with the 9,150 test capacitors divided into thirteen groups on 125C life test. All of the capacitors completed the 1,000 hours parameter measurements and some 3,085 capacitors completed parameter measurements after 2,000 hours on test. Author (TAB)

N67-22679# Genistron, Inc., Los Angeles, Calif.
DEVELOPMENT OF A CURRENT INJECTION PROBE (CIP) FOR HIGH POWER LEVEL FILTER ANALYSIS Final Report
Robert B. Cowdell Nov. 1966 82 p
(Contract NBY-G2222)
(CR-67.013; AD-646050) CFSTI: HC $3.00/MF $0.65

The report describes the successful development of a radio frequency current injection probe capable of injecting amperes of rf current over the frequency range 100 hertz to 1 megahertz into power circuits carrying as much as 200 amperes of 60 hertz or 400 hertz power. The purpose of this development was for the evaluation of power filters with greater than 100 db of attenuation under full rated power load conditions. The significance of 0-10 ohm source and load impedances upon power filter performance is described. Impedance of a typical power source from 16 kilohertz thru 25 megahertz is presented. Author (TAB)

N67-22609# Chalmers Univ. of Technology, Goteborg (Sweden). Electronics Lab.
MEASUREMENTS ON A BEAM-PLASMA MICROWAVE AMPLIFIER
S. Kronlund 1 Aug. 1966 24 p refs
(Contract AF 61(052)-594)
(RADC-TR-67-51; TN-15; RR-68; AD-645748) CFSTI: HC $3.00/MF $0.65

A beam-plasma microwave amplifier with a beam generated argon plasma is described. In the frequency range 2 - 4 GHz the maximum electronic gain was about 5 dB/cm (beam current 2 mA, beam diameter 3 mm, beam voltage 800 V, argon pressure 0.01 torr, focusing field 740 gauss). It is experimentally demonstrated that nonlinearities may under certain conditions raise the gain slightly above the linear, small-signal level. This effect has been theoretically predicted. Furthermore, the electronic gain has been measured as a function of the beam voltage at different frequencies and focusing fields. Author (TAB)

N67-22624*# International Business Machines Corp., Yorktown Heights, N. Y. Watson Research Center.
AUTOMATIC MASK AND WIRING PATTERN GENERATION
Harlow Freitag and Wilm E. Donath *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 15-19 refs (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65

A set of techniques utilizing a computer for the producing of mask sets for integrated circuit manufacture is described. One path is provided for the masks required to fabricate the devices and circuits. Other techniques were developed to design and fabricate the wiring pattern used to interconnect the circuits into a functional array. One such technique employs the Programmed Interconnect Process (discretionary wiring) and is used when high levels of integration are desired for chips having relatively low individual circuit yields. By the use of these techniques it is possible to design a system which will accept circuit schematics as input and automatically produce all the masks needed to fabricate integrated circuit chips in order to implement the given circuit structure in hardware. Author

N67-22678# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
HIGH SPEED SEMICONDUCTOR SWITCH (TWO TERMINAL) AND HIGH SPEED SEMICONDUCTOR SWITCH (GATE) Quarterly Report, 29 May-29 Aug. 1966
Jerry Bravo Sep. 1966 37 p refs
(Contract DA-36-039-AMC-01475(E))
(W-22; QR-13; AD-645480) CFSTI: HC $3.00/MF $0.65

The report presents the results obtained from quality control testing of the three-terminal device, the results of investigating the curing procedures for the two-terminal and 2N1765 devices, and the evaluation of wafer resistivity and thickness for optimum turn-on time of the 2N1765 device. Author (TAB)

N67-22682# Navy Electronics Lab., San Diego, Calif.
IMPROVED HIGH-SPEED INFRARED MAPPING FOR RELIABILITY ASSESSMENT OF MICROCIRCUITRY Research and Development Report, Feb. 1965-Apr. 1966
H. F. Dean 1 Sep. 1966 48 p ref
(NEL-1399; AD-645664) CFSTI: HC $3.00/MF $0.65

Describes modifications to equipment and improved capability in IR mapping since first-generation system described in NEL Report 1272. High-resolution test mappings were successfully made at map-to-object magnifications up to 144x, in 3 minutes, and at environmental temperatures of 45 C to 55 C. Author (TAB)

N67-22722# Tung-Sol Electric Inc., Livingston, N. J. Chatham Electronics Div.
HIGH SPEED POWER AMPLIFIERS USING AN ELECTRON SWITCHED P-N JUNCTION Final Development Report, 27 May 1965-27 Nov. 1966
27 Nov. 1966 40 p
(Contract NObr-93306)
(AD-646006) CFSTI: HC $3.00/MF $0.65

Several 20 KV electron beam multiplier tubes were made to deliver 5 ampere positive pulses of 1 microsecond in duration at 1,000 to 50,000 pps. The diode voltages ranged from 600 to 1,400 volts (saturation point). The current gain was in the range of 2,000 to 4,700. The rise time of the pulse was measured at 10 nanoseconds with an input signal of 10 nanoseconds. A modified standard TV electron gun was used to generate electron-hole pairs in the diodes. Grid cutoff averages 28 volts, and the beam current is approximately 1.6 mA at 50 volts input. Initially some deterioration problems were encountered in the diode when the duty cycle is raised beyond approximately 5%. However the devices fabricated toward the end of this contract do operate at a 10% duty cycle with no apparent deterioration. The gain of the devices made thus far were somewhat below the calculated theoretical 5,000. It is felt that operation at 10% duty cycle and a somewhat higher current are feasible with more effort on diode development. Author (TAB)

N67-22871*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REQUEST ORIENTED INFORMATION SELECTION PROGRAM
Elizabeth Ryan Washington, NASA, Apr. 1967 44 p ref
(NASA-TN-D-3924) CFSTI: HC $3.00/MF $0.65 CSCL 05B

The program is a general purpose information retrieval program which can be used with any file of fixed format documents. The program is easily used by noncomputer personnel and provides flexibility in search requests and output format. These features together with efficient design enable the program to satisfy users' requests for information promptly and inexpensively. In order to ensure easy adaptation of the program to change in computer configuration or manufacturer, it is written entirely in FORTRAN IV. Author

N67-22923# Royal Aircraft Establishment, Farnborough (England).
A CLASS 'A' D.C. COUPLED POWER AMPLIFIER
G. A. Taylor and C. W. Skingle Min. of Aviation, Jul. 1966 42 p refs
(RAE-TR-66231) CFSTI: HC $3.00/MF $0.65

An amplifier which is suitable for current-driving electro-magnetic vibration generators of the type used in resonance testing of aircraft is described. The amplifier has an output impedance of 5000 ohms and can typically supply a load of 3 ohm with a current of ±4 amps while introducing less than 1° phase-shift between the input voltage and output current over the frequency range dc to 2 kc/s. To achieve the high output impedance and response to dc, directly coupled transistors have been used in a current negative-feedback circuit. Author (ESRO)

N67-22958 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ELECTRONIC DEVICES FOR SEMICONDUCTOR RADIATION DETECTORS [UKLADY ELEKTRONOWE DO WSPOLPRACY Z POLPRZEWODNIKOWYMI DETEKTORAMI PROMIENIOWANIA]
Miroslaw Dakowski and Gerard Konador Dec. 1965 27 p refs
(INR-682/I-A/PL) CFSTI: HC $3.00

The necessity of construction of the family of charge sensitive low noise preamplifiers is described. Four schemes of such preamplifiers and the principles of their design are presented. The diagram of universal supply unit for detectors and preamplifiers is added. Author

N67-22963# Royal Aircraft Establishment, Farnborough (England).
A BIBLIOGRAPHY OF STRIP TRANSMISSION LINE REFERENCES
Bryan A. B. Hodgson, comp. London, Min. of Aviation, Nov. 1966 29 p refs
(RAE-LIB-BIBL-269) CFSTI: HC $3.00/MF $0.65

The bibliography covers microstrip or open strip line, double ground-plate lines or triplate, and wire-above-ground lines, and includes a selection of component references. Author

N67-23000# Eigdenossische Technische Hochschule, Zurich (Switzerland).
CONTRIBUTION TO THE IMPROVEMENT OF ELECTROMECHANICAL RELAYS [CONTRIBUTION A L'AMELIORATION DES RELAIS ELECTROMECANIQUES]
Rene Derighetti (Ph.D. Thesis) 1965 75 p refs In FRENCH; ENGLISH summary /*ts* Publ.-50
(Prom.-3654) CFSTI: HC $3.00/MF $0.65

A detailed investigation of contacts using liquids show that, in addition to the normal layout of liquid to liquid contacts, a new arrangement is possible. This is based on the contact separation by the squeezing of a liquid layer. The new arrangement is particularly convenient when constructing either high-speed or small relays, because the amplitude of the switching movement can be smaller than one hundreth of a millimeter. An examination of the working condition of this new device shows the necessity to develop insulating surfaces which will not be wetted by the conducting liquid. The realization of the suggested device is mainly delayed by the difficulties of producing surfaces having the required physical properties. Author

N67-23008# Eidgenossische Technische Hochshule, Zurich (Switzerland).
MICROWAVE RECEIVER SYSTEM WITH DEGENERATE PARAMETRIC PREAMPLIFIER [MIKROWELLENEMPFANGSSYSTEM MIT EINEM DEGENERIERTEN PARAMETRISCHEN VORVERSTAERKER]
Ekkehard Wildhaber 1965 28 p refs In GERMAN
(Prom.-3724) CFSTI: HC $3.00/MF $0.65

This work dealt with the problems of broadband amplifiers in the upper microwave region. Equivalent circuits of diodes involving stray reactances and their incorporation in adjacent matching networks to obtain broad bandwidth have been studied. For this frequency range coaxial structures become impractical. Therefore the amplifier has been designed and constructed in waveguide circuitry. The realized degenerate parametric amplifier operates at 9.4 GHz. The achieved gain is 10 dB with a bandwidth of 680 MHz i.e. an i.f. bandwidth of 340 MHz. The preamplifier single side band noise figure is 5.3 dB. Author

N67-23085 Gt. Brit. Ministry of Aviation, London.
VARIABLE-MAGNETIZATION FERRITE DEVICES: A BIBLIOGRAPHY
Bryan A. B. Hodson, comp. Nov. 1966 11 p refs
(RAE-LIB-BIBL-268) CFSTI: $3.00

This bibliography contains a list of 55 references to variable-magnetization ferrite devices, mounted in waveguide, strip-transmission line and coaxial line. Pulse-magnetized, i.e. latching devices, are not included. The references have been collected from all available sources, and cover the period 1935–1966. An author index is appended. Author

N67-23136# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
SOLID STATE IMAGE INTENSIFIERS, PHASE III: Final Report, 26 Jun. 1963–26 Oct. 1965
Z. Szepesi, R. E. W. Lake, W. A. Thornton, H. D. Wilcox, R. D. Harder et al. Nov. 1966 99 p refs
(Contract N61339-1440)
(NAVTRADEVCEN-1440-2; AD-645590) CFSTI: HC $3.00/MF $0.65

The report describes the work performed: (1) to improve the optoelectronic characteristics of the low resolution (40 lines/inch) PC-EL type image intensifier; (2) to fabricate high resolution (1000 lines/inch) image intensifier panels; (3) to build an experimental compact projection system incorporating the image intensifier panel. As a result of this work, CdSe sintered and plastic embedded layers were produced with conductivities higher than 10 to the minus 7th power mhos/cm at 0.1 ft-c illumination, and with dark conductivities lower than 10 to the minus 8th power mhos/cm. The reproducibility of preparation and life-time of EL thin films have been improved. Low resolution image intensifier panels with improved gain, speed and image quality (grain, uniformity and contrast) have been made. High resolution panels have also been built, but with lower gain and worse image quality than those of the low resolution panel. A compact optical demonstration unit has been constructed for demonstration of the capabilities of the image intensifier panel. Author (TAB)

N67-23140# Centre de Physique Electronique et Corpusculaire, Orsay (France).
HALF MILLIMETER BACKWARD WAVE OSCILLATOR Technical Progress Report, 1 Jul.–30 Sep. 1966
Oct. 1966 15 p
(Contract AF 61(052)-814)
(WR-1638; RADC-TR-67-31; TPR-5; AD-646044) CFSTI: HC $3.00/MF $0.65

The objective of this work is to construct a half-millimeter 'Backward wave oscillator' with a power level in the range of half-a-watt. Electron gun construction and beam transmission have been improved. Spurious phenomena are now completely eliminated. A useful current of about 10mA can be expected through a tunnel of 60 microns in diameter. The protection problem of the line input is not yet solved in the first experimental tubes. Author (TAB)

N67-23162# General Electric Co., Lynchburg, Va. Communication Products Dept.
QUARTZ CRYSTAL UNIT TYPE CR-67/U AND CR-(XM-67)/U PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 28 May–28 Aug. 1966
R. L. Hatcher, H. K. Hoyt, and R. D. Laney 25 Aug. 1966 25 p
(Contract DA-36-039-AMC-06178(E))
(QPR-2; AD-645713) CFSTI: HC $3.00/MF $0.65

The aging study on bonding compounds is scheduled for a maximum of 1000 hours or until a definite trend is established. At this point (approximately 18 days) it appears that good and poor aging is apparent in both the control and test groups. It is also apparent that units tend to be either good or poor from the start of the tests. This would indicate that the reason for the poor aging is due primarily to variations in the processing rather than the bonding materials. With this in mind a careful study will be made to determine the cause of apparent catastrophic and degradational failures from a study of physical variations in the crystal and mounting structure. Author (TAB)

N67-23218# California Univ., Berkeley. Lawrence Radiation Lab.
INTEGRATING WINDOW AMPLIFIER
William W. Goldsworthy 4 Oct. 1966 20 p refs Presented at the 13th Ann. Nucl. Sci. Symp., Boston
(Contract W-7405-ENG-48)
(UCRL-16838) CFSTI: HC $3.00/MF $0.65

A pulse-measuring technique, in which pulses are measured on the basis of area rather than amplitude, is employed in the design of a pulse window amplifier. This pulse-area-integration technique is used primarily to improve linearity, reduce resolution degradation resulting from rise-time jitter, and simplify amplifier drive requirements. Author (NSA)

N67-23261*# General Electric Co., Waynesboro, Va.
RADIOGRAPHIC TECHNIQUES FOR RELIABILITY SCREENING OF RELAYS
W. H. Lesser, R. A. Holcomb, and G. F. Trojanowski 30 Sep. 1966 66 p
(Contract NAS8-20301)
(NASA-CR-83535) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The use of X-rays for identifying and locating defects in hermetically sealed relays is described. Three views through the three coordinate axes are required to detect all defects, although not all may be usable for relays with very high density sections. The radiographic methods were found to detect successfully metallic defects such as tramp metal, solder balls, weld flash, incomplete assemblies, and extra or damaged parts. The radiographic examination did not reveal the presence of low density contaminants such as hair, lint or insulation. Misaligned components and copper wires in excess of 0.002 inch diameter were readily discernable. The X-ray technique was found to be particularly effective for examination of blind final assembly operations, such as internal welds from can to frame and seal-off hole soldering. Details are given on optimum exposure and target to film distances. N.E.N.

N67-23265*# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
SATURN INTEGRATED CIRCUIT RELIABILITY TEST PROGRAM Quarterly Progress Report, Oct.–Dec. 1966
W. F. Gunkel, M. R. Carpenter, and K. R. MacKenzie Dec. 1966 109 p refs
(Contract NAS8-18018)
(NASA-CR-83538; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A test program to ascertain the reliability characteristics of integrated circuits for the Saturn program is described in detail. Four different integrated circuit amplifiers were tested, which differ in their performance characteristics, manufacturing processes, and methods of packaging. Details are given on the electrical characteristics and test measurement techniques. The operating life tests and step stress tests are described, and a literature survey is included. L.E.W.

N67-23292*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AMPLIFIER DRIFT TESTER
Guss E. Wenzel and David Cree Washington, NASA, Apr. 1967 8 p
(NASA-TN-D-3902) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A method was developed which allows automatic measurement of the gain and zero drift characteristics of a dc amplifier during long-term dynamic environmental conditions. A device employing this method compares a source signal, across a voltage divider, with an amplifier output signal. As the signal source is switched between some finite value and zero, the differential voltage between the source and the amplifier output gives an accurate indication of the amplifier gain drift and zero drift. A permanent record of this differential voltage may be obtained on a strip recorder. Measurements of gain and zero drift will be recorded automatically if the signal source is switched repetitiously, as by a motor-driven cam. Four recordings per minute are sufficient to measure drift at temperature gradients as high as 20°F per minute. This information has aided the design of flight-stable dc amplifiers. Author

N67-23322*# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
HIGH RELIABILITY SCREENING OF SEMICONDUCTOR AND INTEGRATED CIRCUIT DEVICES
J. Lombardi, L. McDonough, and H. Padden Washington, NASA, Apr. 1967 161 p refs
(Contract NAS5-9639)
(NASA-CR-721) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The approach was to find methods and techniques for pinpointing the origin of potential failure mechanisms and to employ these techniques in screening devices susceptible to failure. Developed was an integrated screening-acceptance test specification for semiconductor and digital integrated circuit devices to insure high reliability requirements for NASA programs. Acceptance and qualification test specifications are given. Nondestructive tests included external visual and mechanical inspection, X-ray vidicon analysis, electrical tests, burn-in with variables data, and computerized variables analysis. Destructive tests were conducted by decapsulation, microscopic examination, electrical probing, infrared scanning, microsectioning, electron probe microanalysis, and scanning electron microscopy. Test results are tabulated, and a bibliography is included. K.W.

N67-23333*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FLAT CONDUCTOR TECHNOLOGY EXEMPLIFIED
Mar. 1967 13 p
(NASA-TM-X-53584) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Combining printed circuit and flat conductor cable technology led to the development of a unique multilayer printed circuit board which is ideal for reducing weight, saving space, and eliminating other problems that are characteristic of conventional round-wire harnesses. This report portrays the changes made to a typical signal conditioning rack as an example of the evolutionary phases that took place during development of the new board. The results obtained with the new technique show that the method is electrically, mechanically, and economically more practical than that used in preparing conventional round-wire harnesses. Author

N67-23354# Philco Corp., Lansdale, Pa.
LOW COST INTEGRATED CIRCUIT TECHNIQUES Fourth Quarterly Progress Report, 15 Mar.–14 Jun. 1966
S. Wagner and W. Doelp Dec. 1966 43 p
(Contract DA-28-043-AMC-01424(E))
(Rept.-4; ECOM-01424-4; AD-644946) CFSTI: HC $3.00/MF $0.65

A compatible process was developed for the deposition of glass on integrated circuits metalized to facilitate their face-down solder bonding onto printed circuit boards having appropriate copper interconnection patterns. The over-all process is applicable to standard integrated circuits having conventional aluminum interconnections. To conduct 200C life tests, it was necessary to develop a soldering process for use with a suitable printed circuit board material. All of the test vehicles required for low temperature environmental testing were fabricated and submitted for formal testing. Fabrication was begun of the models necessary for the high temperature (200C) tests. Initial evaluation was made of multiple chip assemblies. Several 10-chip arrays were prepared using standard microcircuit chips assembled by the process developed on this program. It has been shown that chips can be removed and new ones attached at the same positions prior to the application of epoxy coating for mechanical protection. This repairability enhances the application of this assembly technique to complex functions. Author (TAB)

N67-23360# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
RADIATION EFFECTS ON ELECTRONIC PARTS AND MATERIALS Quarterly Report, 15 Jun.–14 Sep. 1966
Frank A. Frankovsky Dec. 1966 33 p
(Contract DA-28-043-AMC-02374(E))
(Rept.-7; ECOM-02374-1; AD-645765) CFSTI: HC $3.00/MF $0.65

A series of radiation tests has been completed on mica, Mylar, and polystyrene dielectrics at the Physics International Advanced Flash X-Ray Facility. Capacitors were tested to measure the induced current and replenishment charge as a function of voltage, dose rate, and temperature. Data analysis is not complete; however, relative observations are presented for each dielectric exposed to the short pulse and high radiation level. Author (TAB)

N67-23362# General Electric Co., Lynchburg, Va. Communication Products Dept.
QUARTZ CRYSTAL UNIT TYPE CR-67/U PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 25 Feb.–25 May 1966
R. L. Hatcher, H. K. Hoyt, and R. D. Laney May 1966 31 p refs
(Contract DA-36-039-AMC-06178(E))
(QPR-1; AD-64554) CFSTI: HC $3.00/MF $0.65

Progress is reported on a program to increase the reliability of Quartz Crystal Units CR-67/U per specification SCS-237 by improvements in manufacturing techniques. These improvements will include, but not be limited to (a) blank cleaning, (b) bonding, (c) final plating, (d) curing, (e) sealing, (f) holder cleaning and (g) marking. The increased reliability will be demonstrated by processing 1150 crystals in five frequencies from 17 mc to 61 mc and evaluating the units in an extensive six month test program. Author (TAB)

N67-23373# General Dynamics Corp., San Diego, Calif. General Atomics Div.
RADIATION EFFECTS ON DIELECTRIC MATERIALS Final Report, 1 Jul.–30 Sep. 1966
J. F. Colwell, D. W. De Michele, and R. F. Overmyer Dec. 1966 57 p refs
(Contract DA-28-043-AMC-01412(E))
(ECOM-01412-F; GA-7474; Rept.-5; AD-645535) CFSTI: HC $3.00/MF $0.65

A detailed description of the techniques and equipment employed in the ion-implantation process is presented. Results of high-energy electron irradiation of a Mylar capacitor with ion-implanted electrodes are compared to the response of a control sample. The ion-implanted electrodes exhibit better carrier injection than conventional foil electrodes. Transient radiation effects data from irradiation of a monolithic ceramic capacitor and two glass capacitors are included. One of the glass capacitors contained a semicrystalline dielectric with very high dielectric constant. The transient radiation effects in Mylar versus temperature appear to fit a band model for the conduction process in which a continuous distribution of carrier traps is located in the forbidden zone and one sign of carrier is immobilized. An examination of the energy loss processes of moderately fast electrons in insulators indicates that from 15 eV to 3 eV the energy loss is primarily to excitons whereas energy loss to optical and acoustical phonons occurs down to thermal energies. Author (TAB)

N67-23415# Amperex Electronic Corp., Hicksville, N. Y. Microwave Tubes and Components Dept.
OUTSTANDING RADAR MAGNETRONS
[1967] 17 p refs

An experimental 4 mm radar installation is described which uses various new tubes including a 4 mm magnetron and a 4 mm reflex klystron. The screen images obtained with this installation show that, although the maximum range is no more than a few kilometers, the detail discrimination at short distances is exceptionally good. In addition to a general design discussion specific consideration is given to the modulator circuit, overload protection, receiver, display unit, and ancillary equipment. A.G.O.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-22179*# Philco Corp., Santa Clara, Calif. Microelectronics Div.
[FABRICATION OF AN EIGHT-POLE COMMUTATOR, ASSOCIATED SHIFT REGISTER, CONTROL LOGIC SUBSYSTEM] Quarterly Technical Report, 28 Sep.–31 Oct. 1966
B. Aronson 30 Nov. 1966 30 p Prepared for JPL
(Contracts NAS7-100; JPL-951079)
(NASA-CR-83319; QTR-1) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A preliminary study of alternative implementations of the shift register is briefly reported. A change in manufacturing which allows production of devices with required breakdown voltage is reported. The three-stage counter and decoder, static shift register, and dynamic shift register are briefly described. N.E.N.

N67-22190# Israel Program for Scientific Translations, Ltd., Jerusalem.
A SIMPLIFIED CALCULATION METHOD FOR COMPLEX ASYMMETRIC OPERATING CONDITIONS

N. A. Mel'nikov *In its* 500 kV Long-Distance Electric Transmission 1966 p 146–151 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

A simplified method is presented for calculating asymmetric operating conditions in electric networks which has a high degree of accuracy, even in the first approximation. The calculations are based on the method of symmetrical components of positive, negative, and zero phase sequence. The parameters of the elements of the equivalent circuit of the three phase system, which determine the influence of the currents and voltages of one sequence on those of the other sequences, have certain values. These values are considerably smaller than for the corresponding parameters, which determine this influence in each sequence separately. Since the moduli of the currents and voltages of the negative and zero sequences are smaller than for the currents and voltages of the positive sequence, the calculation of operating conditions applying to the positive sequence can be made to a first approximation, without considering the effect of the voltages and currents of the negative and zero sequences. Calculations are made using the usual equivalent circuit applicable to the symmetrical operating conditions of the circuit. Average values of impedance and admittance are used for all three phases. R.N.A.

N67-22192# Israel Program for Scientific Translations, Ltd., Jerusalem.

CORONA LOSSES OF HIGH-VOLTAGE A-C LINES

N. N. Tikhodeev *In its* 500 kV Long-Distance Electric Transmission 1966 p 169–188 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The results of corona loss measurements on high voltage ac lines have been analyzed and simplified methods of calculating average annual corona losses have been devised and shown to be valid. As a result, principles explaining the corona loss phenomena have been formulated. The discussion covers laws for determining average corona losses, the reduction of radio interference due to 220 to 759 kV lines, corona losses as a function of conductor cross section, and corona effect on the optimum size of conductors. R.N.A.

N67-22201# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE CONSTRUCTION OF 500 kV TRANSMISSION LINES

Yu. E. Grigor'ev and V. S. Kondakhchan *In its* 500 kV Long-Distance Electric Transmission 1966 p 325–345 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The materials and methods used in constructing high voltage transmission lines are described, including the use of precast reinforced concrete foundations, both steel and reinforced concrete guyed tangent supports, line accessories, the method of stringing conductors, repair and communications facilities, and the organization of line construction. Two examples are given to illustrate the basic operations involved in constructing 500 kV transmission lines. R.N.A.

N67-22202# Israel Program for Scientific Translations, Ltd., Jerusalem.

OPERATION AND MAINTENANCE OF 400–500 kV TRANSMISSION LINES

A. S. Zelichenko *In its* 500 kV Long-Distance Electric Transmission 1966 p 346–362 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

The equipment and methods used and the problems encountered in the operation and maintenance of high voltage transmission lines are described. Line failures due to lightning, icing, and conductor dancing are discussed along with methods for reducing them. Insulator defects, another major problem area, are examined, and the organization of line operation and maintenance and basic maintenance operations are outlined. R.N.A.

N67-22214*# Alabama Univ. Research Inst., Huntsville.

OPTIMAL CONTROL WITH CHEBYSHEV MINIMAX PERFORMANCE INDEX

C. D. Johnson *In its* Study of Optimal and Adaptive Control Theory .Apr. 1967 p 3–46 refs Presented at the 1966 Joint Automatic Contol Conf., Seattle, Aug. 1966 Submitted for publication (See N67-22213 11-19) CFSTI: HC $3.00/MF $0.65 (Grant NsG-381)

The optimal control of dynamical systems with a certain minimax type performance index, which cannot be expressed in the Mayer, Lagrange, or Bolza format, is studied. The form of the optimal control is described and certain geometric properties of the solution are discussed. Several examples are worked in detail to illustrate application of the proposed method of solution. Author

N67-22215*# Alabama Univ. Research Inst., Huntsville.

THREE EXAMPLES OF DIFFERENTIAL GAME PROBLEMS IN OPTIMAL CONTROL THEORY

C. D. Johnson *In its* Study of Optimal and Adaptive Control Theory Apr. 1967 p 47–57. refs (See N67-22213 11-19) CFSTI: HC $3.00/MF $0.65

The purpose of this study is to illustrate, by examples, the type of optimal control problems which can be solved by application of the theory of differential games. The method of solution is based on the combined application of the classical Hamilton–Jacobi–Carathéodory theory of a value function and the principle of optimality. The first example illustrates a differential game with quadratic performance index and hard inequality constraints on both controls. The second example illustrates a bounded control differential game which possesses a singular solution—a situation which is quite common in this class of problems. The last example is the differential game analog of the classical optimal linear regulator problem. Author

N67-22216*# Alabama Univ. Research Inst., Huntsville.

A NOTE ON THE TRANSFORMATION TO CANONICAL (PHASE-VARIABLE) FORM

C. D. Johnson and W. M. Wonham (Martin Co., Baltimore) *In its* Study of Optimal and Adaptive Control Theory Apr. 1967 p 59–64 refs (See N67-22213 11-19) CFSTI: HC $3.00/MF $0.65

(Contracts AF 49(638)-1206; AF 33(657)-8559)

A theorem is derived to obtain the matrix theoretic structure of and computational algorithms for a required transformation matrix. The theorem demonstrates the applicability of the "phase-variable canonical form" for single-input linear dynamical systems to the area of modern linear control theory. A third-order system is considered to provide an example application. A.G.O.

N67-22217*# Alabama Univ., Research Inst., Huntsville.

ANOTHER NOTE ON THE TRANSFORMATION TO CANONICAL (PHASE-VARIABLE) FORM

C. D. Johnson and W. M. Wonham (Brown University) *In its* Study of Optimal and Adaptive Control Theory Apr. 1967 p 65–71 refs (See N67-22213 11-19) CFSTI: HC $3.00/MF $0.65

(Grant NsG-381)

The problem of determining a nonsingular linear transformation which will take an arbitrary, completely controllable, single-input, time-variant linear dynamical system into the canonical (phase variable) form is considered. The inherent computational features of the transformation method are pointed out, in detail, and relationships with controllability and observability are described. In addition to the general numerical method for determining the matrix K, algebraic methods in terms of the fundamental matrix theoretic notions of eigenvalues and eigenvectors are also presented. A.G.O.

N67-22218*# Alabama Univ. Research Inst., Huntsville.
INVARIANT HYPERPLANES FOR LINEAR DYNAMICAL SYSTEMS
C. D. Johnson *In its* Study of Optimal and Adaptive Control Theory Apr. 1967 p 73–84 refs (See N67-22213 11-19) CFSTI: HC$3.00/MF$0.65
(Grant NsG-381)

In certain problems associated with the control of linear dynamical systems, the concept of invariant hyperplanes in the system state space plays an important role. This paper gives conditions for the existence of invariant hyperplanes for linear dynamical systems and describes some geometric properties of these hyperplanes. In addition, some relationships between invariant hyperplanes and the concepts of controllability and observability are discussed. Author

N67-22401# Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, NO. 6, 1966
14 Feb. 1967 315 p refs Transl. into ENGLISH of Izv. Akad. Nauk SSSR, Tekhn. Kibernetika (Moscow), no. 6, Nov.–Dec. 1966 p 1–192
(JPRS-39890; TT-67-30538) CFSTI: HC$3.00/MF$0.65

Articles on general problems in control theory and investigation of operations, queueing systems and reliability problems, pattern recognition, automatic control, and current events are presented. For individual titles see N67-22402–N67-22425.

N67-22404# Joint Publications Research Service, Washington, D. C.
A STOCHASTIC PERT SYSTEM, 1
G. S. Pospelov and V. A. Barishpolets *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 20–36 refs (See N67-22401 11-10) CFSTI: HC$3.00/MF$0.65

One of the possible approaches is investigated to the construction of a PERT model with a stochastic structure, and a procedure is given for its analysis. Possible areas of application of a stochastic PERT system are indicated. Author

N67-22407# Joint Publications Research Service, Washington, D. C.
A METHOD OF CONSTRUCTION OF THE REGION OF ALLOWABLE VALUES OF PARAMETERS OF THE ELEMENTS OF AUTOMATIC CONTROL SYSTEMS
V. V. Zdor and I. D. Kochubiyevskiy *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 73–80 refs (See N67-22401 11-10) CFSTI: HC$3.00/MF$0.65

In accord with the technical conditions in the design of automatic control systems the problem of determination of the region of allowable values of parameters of the elements of an automatic control system is posed. The algorithm is described for construction of these regions using a computer. Author

N67-22410# Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF SERVICING COMPLEX TECHNICAL SYSTEMS, 1
Ye. Yu. Barzilovich *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 102–125 refs (See N67-22401 11-10) CFSTI: HC$3.00/MF$0.65

A brief review is offered of basic works in the area of control of reliability of complex technical systems during operation and design. Author

N67-22411# Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE OPTIMAL PREVENTIVE MAINTENANCE SCHEDULE FOR A COMPLEX CONTINUOUS ACTION SYSTEM
S. A. Podlepa *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 126–135 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF$0.65

The optimal preventive maintenance schedule is determined for a complex, continuous action system (with preventive maintenance carried out in turn of its subsystems) from the conditions of assurance of the maximum probability of keeping the system in a state of good repair at any point in time. The flows of failures of the subsystem are Poisson nonstationary flows; the repair time distributions are arbitrary. Author

N67-22413# Joint Publications Research Service, Washington, D. C.
THE LIFE OF A SYSTEM UNDER NONHOMOGENEOUS OPERATING CONDITIONS
O. V. Viskov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 144–147 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF$0.65

A model is proposed for calculation of the reliability of a system taking into account the nonhomogeneous nature of use of the system. The La Place–Stiltjes transformation of the time distribution of trouble-free operation of the system is calculated. Author

N67-22414# Joint Publications Research Service, Washington, D. C.
AN ALGORITHM FOR TRAINING A LINEAR PERCEPTRON
K. A. Blazhkin and V. M. Fridman *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 148–159 refs (See N67-22401 11-10) CFSTI: HC$3.00/MF$0.65

An algorithm for training an α-perceptron is proposed. The convergence of the training process in a finite number of steps for a fixed training sequence is proved. The relationship of the training methods to iteration procedures for the solution of linear algebraic equations is indicated. Author

N67-22415# Joint Publications Research Service, Washington, D. C.
PATTERN RECOGNITION IN THE SELF-TRAINING MODE
V. A. Laptev and A. V. Milen'kiy *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 160–167 refs (See N67-22401 11-10) CFSTI: HC$3.00/MF$0.65

A two-alternative case is investigated. The criterion of mutual compactness of the recognized pattern is introduced on the basis of which the algorithm of sequential recognition is constructed. Some results of experimental checking of the algorithm obtained are presented. Author

N67-22416# Joint Publications Research Service, Washington, D. C.
SOME PRINCIPLES IN THE FORMATION OF ATTRIBUTES IN PATTERN RECOGNITION
V. O. Korsunskaya *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 168–177 refs (See N67-22401 11-10) CFSTI: HC$3.00/MF$0.65

Some principles are defined for forming on the basis of a given system of attributes a new system of uncorrelated attributes of pattern recognition of least dimension. In the case of multiple-dimension normal distribution of the initial attributes for the given classes of patterns the algorithms for obtaining new attributes are investigated. Examples are presented as applied to the recognition of letters. Author

N67-22417# Joint Publications Research Service, Washington, D. C.

A RECOGNITION SYSTEM BASED ON ANALYSIS OF THE ORIENTATION OF LOCAL SEGMENTS OF AN IMAGE

V. P. Romanov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 178–186 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

A new method of analysis of images and the detection of directionalness of the local segments of the image and a method of pattern recognition based on this analysis are described. The results of operation of the program which compiles the description of the image in the form of a two-dimensional vector field are presented. A comparison is made of the proposed method with the existing ones. Author

N67-22419# Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN MULTI-DIMENSIONAL FILTRATION OF PROCESSES WITH STATIONARY DERIVATIVES

I. A. Bol'shakov and E. N. Khomyakov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 195–209 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

Multidimensional (matrix) filters for optimal separation of the set of processes with stationary derivatives from their mixtures with white noise are found. The separated processes are the k–th integrals of white noise (k = 1,2,3) and are correlated among themselves. In the general case white noise is also correlated. Variation in the structure of the filter according to the degree of increase in the order of k processes has been discovered; the resultant accuracy of reproduction and gains insured in processing of the input mixtures are investigated. Author

N67-22420# Joint Publications Research Service, Washington, D. C.

SELECTION OF THE TYPE OF AUTOMATIC SYSTEMS FOR INCOMPLETE A PRIORI INFORMATION

Yu. M. Kozlov and R. M. Yusupov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 210–221 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

One of the possible approaches to the selection of the type of automatic system for incomplete a priori information is investigated. The generalized accuracy of the system is evaluated in advance from the point of view of its roughness. The final selection of the type of system is made with respect to the efficiency criterion. Author

N67-22421# Joint Publications Research Service, Washington, D. C.

RELAY AUTOMATIC CONTROL SYSTEMS FOR OBJECTS WITH A LARGE RANGE OF VARIATION OF DYNAMIC CHARACTERISTICS

V. M. Bozhukov, V. I. Kukhtenko, V. F. Levitin, and B. F. Shumilov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 222–236 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

The circuits and autooscillatory conditions are investigated in systems with two relay elements, and it is shown that the use of two relay elements extends the possibilities of stabilization of the dynamic characteristics of a closed system on variation of the characteristics of the object by comparison with the known circuits with one relay element. Author

N67-22422# Joint Publications Research Service, Washington, D. C.

THE THEORY OF FORCED CONDITIONS OF SELF-ADJUSTMENT IN SYSTEMS WITH SEARCH MODULATION OF THE PARAMETERS

V. K. Obabkov and Yu. I. Alimov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 237–246 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

The method of investigation of nonquasistationary processes in self-adjusting systems with an auxiliary operator is extended to systems with search modulation. The concept of the bilinear link of an automatic system and its frequency characteristics are used. Author

N67-22423# Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF QUALITY OF CONTROL IN PROBLEMS OF ANALYTICAL DESIGN OF OPTIMAL REGULATORS

V. N. Romanenko *In its* Tech. Cybernetics, no. 6, 1966 14 Feb. 1967 p 247–254 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

A procedure is proposed for definition of the weight coefficients of an optimizing functional in problems of analytical design of optimal regulators beginning with the condition of realization of some given quality of the system. Author

N67-22424# Joint Publications Research Service, Washington, D. C.

REALIZATION OF FUNCTIONS OF ANALOG LOGIC USING MAGNETIC ELEMENTS

M. A. Rosenblatt *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 255–268 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

Methods of execution of logical operations on continuous variables are investigated with the help of controlled choke coils and magnetic amplifiers which are simultaneously amplifiers of the input signals. Author

N67-22425# Joint Publications Research Service, Washington, D. C.

III ALL-UNION CONFERENCE ON INVARIANCE THEORY AND ITS APPLICATION IN AUTOMATIC CONTROL SYSTEMS

In its Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 269–270 (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

Approximately 500 specialists, representing 138 scientific, research, industrial organizations, and educational institutions, participated in the III All-Union Congress on Invariance Theory and its Application in Automatic Control Systems, from May 31 to June 5, 1966, in Kiev. In addition to the 139 reports given, discussions were held on basic problems of the invariance theory. Various conference subgroups discussed: general problems in invariance theory; combined control systems, invariance in discrete systems; nonlinear invariance systems; invariance and sensitivity theory, invariant self-adjusting systems; invariance in multidimensional automatic systems; applied problems in invariance theory for moving objects; and the industrial application of invariant systems. R.Ll.

N67-22446# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF NON-STATIONARY OSCILLATIONS IN NONLINEAR SYSTEMS

Yu. A. Mitropol'skiy 30 Aug. 1966 57 p refs Transl. into ENGLISH from the book "Prilozheniya Metodov Teorii Nelineynykh Kolebaniy k Zadacham Fiziki i Tekhniki." Tr. Simpoziuma Kiev, Izd-vo An UKRSSR, v. 3, 1963 p 241–474 (FTD-T-65-117; TT-67-60264; AD-643960) CFSTI: HC $3.00/MF $0.65

A method is described of investigation of nonstationary oscillatory processes in nonlinear systems with slowly varying parameters. The problem of passing through resonance in nonlinear oscillatory systems with one and more degrees of freedom is

considered in detail as well as the problem of passing through parametric resonance and some other typical problems of physics and technics connected with nonstationary oscillations (resonance phenomena in accelerators, passing through resonance in gyroscopic systems, etc.). Author (TAB)

N67-22487# Royal Aircraft Establishment, Farnborough (England).
TABULATED DATA ON MATRIX RELATIONSHIPS IN ELECTRONIC TWO-PORT NETWORKS
G. May and G. Brown Aug. 1966 13 p refs
(RAE-TR-66259) CFSTI: HC $3.00/MF $0.65

Following a discussion of current conventions in two-port networks, tabulated data are presented to enable the electronic engineer to change quickly from one set of matrix parameters to another. Further data on matrixes particularly applicable to computations, in both passive and active networks, are given. All the data were prepared using the positive inwards current convention. Author (ESRO)

N67-22495# European Space Vehicle Launcher Development Organization, Paris (France).
SOME REMARKS ON THE PHASE-LOCK LOOP
E. Cambi *In its* ELDO Tech. Rev., Vol. I, No. 3 1966 p 233–244 refs (See N67-22491 11-31) CFSTI: HC $3.00/MF $0.65

The classic results giving the optimal values (in Wiener's sense) of the parameters of the filter in a phase-lock loop are deduced through a simplified analysis, and extended to loops of any order. Some simple arguments show, however, that this optimum condition is not too drastic and some, even significant, deviations from the optimum can actually improve the performance of the loop. Author (ESRO)

N67-22527# Air Force Cambridge Research Labs., Mass. Microwave Physics Lab.
OPTIMUM DESIGN OF SYMMETRICAL PARALLEL-T R–C NETWORKS
Tom G. Purnhagen Oct. 1966 17 p refs *Its* Phys. Sci. Res. Papers No. 282
(AFCRL-66-733; AD-645749) CFSTI: HC $3.00/MF $0.65

The paper presents the information necessary for the design of symmetrical parallel-T R-C networks with symmetrical frequency response such that the networks will have optimum characteristics subject to certain circuit or performance constraints. Three cases are considered: (1) design for maximum Q when source and load resistances are specified; (2) design for maximum Q when minimum acceptable gain is specified; (3) design for maximum gain-Q product when source and load resistances are specified. Data are presented showing the trade-off between gain and Q as circuit parameters are varied. Author (TAB)

N67-22533# Pennsylvania Research Associates, Inc., Philadelphia.
SELF-REPAIR THEORY INVESTIGATION
Edward W. Veitch Dec. 1966 90 p refs
(Contract DA-28-043-AMC-02344(E))
(ECOM-0344-1; U66-998; QR-1; AD-645556) CFSTI: HC $3.00/MF $0.65

A study was made to develop a theory of self-repair in digital nets via fault diagnosis and automatic circuit replacement. Several theorems are developed concerning which experiments need to be performed on a given net in order to check its proper operation. The study shows how the Sequential Prime Implicant Form for representing a sequential net can be factored into a minimal covering set of projections, each of which represents a partial description of the net behavior. Author (TAB)

N67-22553# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF ROOT HODOGRAPH IN THEORY OF AUTOMATIC CONTROL
E. G. Uderman 26 Jul. 1966 115 p refs Transl. into ENGLISH of the book "Metod Kornevogo Godografa v Teorii Automaticheskogo Upravleniya" Moscow, Mashqiz., 1963 p 1–112
(FTD-MT-65-513; TT-67-60489; AD-645792) CFSTI: HC $3.00/MF $0.65

The book contains a systematic account of the root hodograph method (root locus method), which is a graphoanalytical calculation of linearized systems of automatic control in time field. In the book is given necessary information about linearized systems, essence of method of property of root hodographs is expounded, and appraisal of parameters of transition and frequency-response curves of system depending upon location of zeroes and poles of transfer function of closed system is given. Questions are considered of synthesis of systems of automatic control using root hodograph technique. All presented questions are illustrated by examples of calculations. Book is intended for scientists, engineers, and students studying calculation of systems of automatic control. Author (TAB)

N67-22580# RAND Corp., Santa Monica, Calif.
ON THE DYNAMIC PROGRAMMING TREATMENT OF DISCRETE-TIME VARIATIONAL PROBLEMS
S. E. Dreyfus Dec. 1966 31 p refs
(Contract AF 44(620)67-C-0045)
(RM-5159-PR; AD-645106) CFSTI: HC $3.00/MF $0.65

The study considers a modification of the usual continuous-time optimal control problem, in which a decision, chosen from a continuum of admissible decisions, is rendered at each of a discrete and finite set of points in time. Dynamic programming techniques are used to derive two necessary conditions for relative minimality of a trajectory under the rather strong assumption of sufficient smoothness of the optimal value function. Under certain convexity assumptions, a maximum principle of Pontryagin type is also deduced, although, in general, there is no such principle for discrete problems. Author (TAB)

N67-22617# New York Univ., N. Y. Lab. for Electroscience Research.
DESIGN OF ADMITTANCES USING PARALLELED RESONATORS
John F. O'Neill and Mohammed S. Ghausi Sep. 1966 113 p refs
(Contract AF 19(628)-5537)
(AFCRL-66-756; TR-400-143; SR-3; AD-646215) CFSTI: HC $3.00/MF $0.65

The report presents an extension and application of Maximally Flat Magnitude Driving Point Functions to the design of flat band-pass admittances using approximation procedures. Poles are pre-specified according to the low pass MFM array described in a previous paper. The resonator inverse inductances are taken as coefficients to be manipulated for the desired flat magnitude response. A tabulation of the sensitivities of the magnitude response at various frequencies to these parameters was shown to be sufficient for the design of flat driving point functions. A continuum of paralleled resonators with parameters distributed in some arbitrary continuous variable x was studied. It was shown that the properties of this function are closely related to the properties of a discrete paralleled resonator distribution with similar parameters. Realization of a general specified admittance magnitude using only paralleled resonators, and including shunt capacitance, is shown to be possible to within a ripple in magnitude. Several examples of admittance shapes are realized using a program designed on this basis. Methods are presented for analysis and design of a usefully large variety of admittances using only paralleled resonators. Author (TAB)

N67-22621*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
COMPUTER-AIDED CIRCUIT DESIGN SEMINAR
1967 124 p refs Seminar held from 11–12 Apr. 1967 (NASA-TM-X-59610) CFSTI: HC $3.00/MF $0.65 CSCL 09C

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N67-22622*# International Business Machines Corp., Poughkeepsie, N. Y. Systems Development Div.
COMPUTER METHODS OF NETWORK ANALYSIS
Franklin H. Branin, Jr. *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 3–5 ref Presented at the IEEE Intern. Conv., New York, 20–23 Mar. 1967 (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65
(IBM-TR-00-1562)

The network problem concerned with predicting the behavior of a system of interconnected elements in terms of the element characteristics and the manner of interconnection of these elements is discussed. The formulation of the network problem by a matrix-topological method; and analyses of the problem by the classical mesh, node, cutset, and mixed methods, are briefly reviewed. The mixed method is applicable to dc and ac network problems as well as to transient problems. Numerical techniques for solving both linear and nonlinear dc problems, and ac problems, are discussed. The importance of the computer influence in these techniques is stressed. L.S.

N67-22623*# Bell Telephone Labs., Inc., Murray Hill, N. J.
OLCA: AN ON-LINE CIRCUIT ANALYSIS SYSTEM
Hing C. So In NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 9–11 refs (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65

A software system for on-line analysis of linear networks is described. Inputs to the system such as circuit diagrams are given via a light pen and a teletypewriter. Analysis results are available in various forms, including oscilloscope displays of frequency characteristics. The system guides the user through necessary steps by displayed comments. It also checks for user's errors. Author

N67-22625*# Bell Telephone Labs., Inc., Murray Hill, N. J.
THE DESIGN OF DIGITAL FILTERS
James F. Kaiser In NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 23–26 refs (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65

Two commonly used digital filter design methods are discussed. This is followed by a general description of a digital filter design program which is capable of generating discrete representations for linear continuous filters including a wide variety of the classic filter forms. The paper concludes with comments on the application of the program. Author

N67-22626*# Los Alamos Scientific Lab., N. Mex.
NET-2 CIRCUIT ANALYSIS PROGRAM
Allan F. Malmberg In NASA, Electron Res. Center Computer-Aided Circuit Design Seminar 1967 p 29–32 Sponsored by AEC (See N67-22621 11–10) CFSTI: HC $3.00/MF $0.65

General features of the program are presented. This program, under development on the MANIAC computer, will perform nonlinear DC and transient analysis and linearized AC analysis of arbitrary circuit configurations. The language for describing the circuit schematic is presented in detail. Features for inclusion of models of various linear and nonlinear devices are discussed. The program is written so as to permit device models to be added without rewriting NET-2 itself. Models and their parameter values are stored in a model library and called into the calculation automatically. Input facilities are included for superseding library values of device parameters. Author

N67-22627*# Rice Univ., Houston, Tex.
AUTOMATIC TRANSIENT A-C SENSITIVITY ANALYSIS WITH APPLICATIONS
J. Venn Leeds, Jr. In NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 35–38 refs (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65
(Grants NSF GK-262; NSF GU-1153)

A method of sensitivity calculations for single parameter and multiple parameter sensitivities has been developed. The method has a direct interpretation in terms of network configuration. Furthermore, it may be used on existing digital computer network analysis programs without modification. The ease with which multiple parameter sensitivity calculations can be made has been used to analyze continuously equivalent networks and the mathematical model of the human cochlea. Author

N67-22628*# Boeing Co., Seattle, Wash.
CIRCUS, A DIGITAL COMPUTER PROGRAM FOR TRANSIENT ANALYSIS OF ELECTRONIC CIRCUITS
Richard H. Dickhaut *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 41–43 refs (See N67-22621 11-10) CFSTI: HC $3.00/MF $0.65

CIRCUS is a digital computer program which simulates the time domain response of an electronic circuit to an arbitrary forcing function. Although motivation for the development of CIRCUS originated from efforts to evaluate transient nuclear radiation effects on electronics, the program is applicable to the much

wider class of everyday electronic design problems, and any physical system having an electrical analogue. Like other time domain circuit analysis programs, CIRCUS requires a topological description of the circuit which specifies element values and forcing functions, and from this information constructs the appropriate time-domain equations, finds the dc initial conditions, and then evaluates the transient solution by numerical integration of the differential equations. Significant features of the program are its speed, flexibility, easy input and output programming, and present availability on four different computer systems. Author

N67-22629*# Sandia Corp., Albuquerque, N. Mex.
TOPOGRAPHIC SIMULATION AS AN AID TO PRINTED CIRCUIT BOARD DESIGN
Clifford J. Fisk, Leslie E. West, and David Caskey *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 47–53 refs Sponsored by AEC (See N67-22621 11-10) CFSTI: HC$3.00/MF$0.65

A method was programmed to produce the conductor path layout as part of the continuing development of the ACCEL system. The method is based on a topographic simulation scheme where component connector pin locations are represented by peaks, and the areas between pins are represented by combinations of slopes, plains and valleys. Examination of this terrain can lead to the establishment of trails to represent conductor paths. Also, methods of displaying the simulated topography and trails were programmed. Although this presentation is centered around the circuit board problem, the technique may be useful in other problems of a contextual nature. Author

N67-22630*# International Business Machines Corp., Owego, N. Y. Federal Systems Div.
SCEPTRE: A SECOND GENERATION TRANSIENT ANALYSIS PROGRAM
Stephen R. Sedore *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 57–81 refs (See N67-22621 11-10) CFSTI: HC$3.00/MF$0.65

SCEPTRE (System for Circuit Evaluation and Prediction of Transient Radiation Effects) is discussed. Two basic incidence matrices that apply to any connected electrical network composed of resistances, capacitances, inductances, voltage sources and current sources are used to derive a general F matrix. The F matrix is used in turn to establish very practical relations between the tree branches and links of the general electrical network. It is shown that this relationship is exploited to form an efficient algorithm that is used in forming some of the equations that are required for a general transient solution. Also described are the most important features that are available to aid in the practical solution of contemporary networks. Author

N67-22631*# International Business Machines Corp., Huntsville, Ala. Federal Systems Div.
COMPUTER-ASSISTED CIRCUIT ENGINEERING
John A. Zumbado and John B. Eggerling *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 65–71 ref (See N67-22621 11-10) CFSTI: HC$3.00/MF$0.65

Accurate and timely circuit engineering is based upon: (a) accurate circuit parameter characterization, (b) flexible network analysis computer programs, (c) continuous computer program development, and (d) empirical investigations in adequate laboratories. This paper shows how these criteria are applied to obtain meaningful circuit analysis results. Typical examples of circuit performance obtained through computer-assisted analyses are given and compared to measured results. Author

N67-22633*# National Aeronautics and Space Administration, Electronics Research Center, Cambridge, Mass.
NASAP: NETWORK ANALYSIS FOR SYSTEMS APPLICATIONS PROGRAM: PRESENT CAPABILITIES OF A MAINTAINED PROGRAM
Richard M. Carpenter *In its* Computer-Aided Circuit Design Seminar 1967 p 85–94 refs (See N67-22621 11-10) CFSTI: HC$3.00/MF$0.65

Present capabilities of NASAP are discussed including flowgraph construction and evaluation, input-output formulation and available subroutines. Strengths and weaknesses are presented, together with plans for future development. Author

N67-22634*# Air Force Special Weapons Center, Kirtland AFB, N. Mex.
A SURVEY OF TRANSIENT CIRCUIT ANALYSIS PROGRAMS
Gary K. Pritchard *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 97–104 refs (See N67-22621 11-10) CFSTI: HC$3.00/MF$0.65

The basic features of ten automated nonlinear transient circuit analysis programs are listed and the values of each of the features discussed from a potential user's viewpoint. The features compared for each program include the types of analysis performed, the types of elements handled, built-in models, the computers on which the programs are operational, documentation, program availability, user convenience, special features, and mathematical solution formulation. Author

N67-22635*# Bendix Corp., Baltimore, Md.
A USER'S VIEW OF ECAP
Leonard Danker *In* NASA, Electron. Res. Center Computer-Aided Circuit Design Seminar 1967 p 107–122 (See N67-22621 11-10) CFSTI: HC$3.00/MF$0.65

Partial derivatives and sensitivity coefficients for the DC analysis options are presented. The partial derivatives refer to the rate of voltage change at a particular node with respect to a circuit parameter in a particular branch. The sensitivity coefficients are defined as the change in node voltage for a 1% change in the branch parameter. The maximum solution for a worst case solution is presented. The frequency variation of the AC options; and the time dependent voltage and current sources for the transient analysis options, are discussed. Diagrams of the circuits involved are depicted. Tables of the values for the partial derivatives, sensitivities, and standard deviations of the node voltages are given. L.S.

N67-22723# Harry Diamond Labs., Washington, D. C.
CIRCUIT PARAMETERS FOR OPTIMUM QUADRATRON PERFORMANCE
Howard M. Bloom Oct. 1966 24 p refs
(HDL-TM-66-15; AD-645735) CFSTI: HC$3.00/MF$0.65

The range of effectiveness of a Quadratron when it is used as a square-root element can be extended with the addition of compensating series and parallel resistors. The report explains how to find optimum circuit parameters by using curve fitting techniques on the digital computer. The Chebyshev norm and the least squares norm are used to obtain a best approximation. Several cases were tested for a set of five Quadratrons and the results were excellent. Author (TAB)

N67-22726# RAND Corp., Santa Monica, Calif.
ORTHONORMAL BASES FOR EXPONENTIAL AND RATIONAL FUNCTION APPROXIMATIONS OF NETWORK AND SIGNAL CHARACTERISTICS

M. I. Liechenstein Jan. 1967 140 p refs
(Contract AF 44(620)67-C-0045)
(RM-5177-PR; AD-645916) CFSTI: HC$3.00/MF$0.65

Numerous problems encountered in the analysis, synthesis, and identification of systems become intractable when certain system attributes are represented by polynomials. In many instances, such unwieldy formulations may be circumvented by approximating these attributes by the more naturally suited exponential functions or by those rational functions whose denominator polynomials are not necessarily constant. This study considers two special sets of elements, one constituting a basis for exponential approximation and the other providing a basis for rational function approximation. Author (TAB)

N67-22870*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MINIMUM ENERGY REACTION WHEEL CONTROL FOR A SATELLITE SCANNING A SMALL CELESTIAL AREA
William R. Wehrend, Jr. and Michael J. Bondi Washington, NASA, Apr. 1967 29 p refs
(NASA-TN-D-3922) CFSTI: HC$3.00/MF$0.65 CSCL 22A

A scheme is developed for commanding a spacecraft to perform a precise, predetermined maneuver. The example considered is an Advanced Orbiting Solar Observatory performing a raster scan over a small celestial area. During the scan, the position error is required to be less than a prescribed amount at any given time. To satisfy this requirement the transition between scan lines must be smooth to avoid both velocity and position errors at the start of the subsequant scan. To accomplish a smooth transition and state at the ends of the scan line is specified and the variational form of optimal control theory is used to find the command that will use the minimum amount of energy. The scheme was tested by having it control a table mounted on a spherical gas bearing. The control torque was generated by reaction wheels, and the command was calculated by a digital computer. The test maneuver was a simple repetitive scan along two parallel lines. Author

N67-22941# Eidgenossische Technische Hochschule, Zurich (Switzerland).
INVESTIGATION OF EFFECTS OF EXTREME STRUCTURAL FLEXIBILITY OF FLIGHT VEHICLES WITH FEEDBACK-CONTROL-SYSTEM STABILIZATION
Hubert Ivan Flomenhoft (Ph.D. Thesis) 1965 142 p refs *Its* Dissertation No. 3600
CFSTI: HC$3.00/MF$0.65

Results are presented of a study of the effects of exterme structural flexibility on the dynamic characteristics of a flight vehicle that requires an automatic feedback control system for stabilization. The vehicle used is the hypothetical missile-type configuration having a long, very slender body with small, rigid aerodynamic surfaces forward and aft, with a first body-bending frequency of one cycle per second, and is to fly at very high dynamic pressure so that aeroelastic instabilities are severe. It is shown that, when the vehicle is unstable in divergence of the coupled pitching and first-bending modes, it can be stabilized with feedback control of the canard surfaces, but feedback control of the tail is generally destabilizing. Furthermore, control by means of one aerodynamic surface (single-actuator control) cannot stabilize the system when a dynamic instability exists in combination with the pitching static instability. Stability and achievable dynamic performance are highly dependent on the locations and areas of the aerodynamic surfaces and the location of the gyroscope. For canard control, the gyroscope must be located well forward, but somewhat aft of the nose. Author

N67-23019# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
PROPOSAL FOR A NEW TYPE OF CAVITY RESONATOR [PROPOSTA DI NUOVI DI RISUONA TORI A]
M. Puglisi 14 Nov. 1966 6 p In ITALIAN *Its* Nota Interna No. 335
(LNF-66/54) CFSTI: HC$3.00/MF$0.65

Brief technical details are given on a proposal for designing a smaller size cavity resonator. Interest is concentrated on the Joule effect of the charged resonator, for application to accelerators. There was good agreement between experimental and theoretical results with regard to decreasing the geometric proportions of the resonator. Transl. by R.Li.

N67-23110# Illinois Univ., Urbana. Coordinated Science Lab.
SEMI-TOPOLOGICAL ANALYSIS OF LINEAR NETWORKS
T. Kamae Dec. 1966 24 p refs
(Contract DA-28-043-AMC-00073(E); Grant AF-AFOSR-913-66)
(R-332; AD-645757) CFSTI: HC$3.00/MF$0.65

For the diagnosis of linear networks, topological formulas for network functions are found convenient. However, one has to generate all the trees and 2-trees of the network, whose number is generally very big. In practice, one encounters the situation in which some elements are more important than others. The paper presents a method of analysis which enables us to obtain network functions, leaving only several elements in a symbolical expression, so that one can study the effect of the variations of those elements. Author (TAB)

N67-23111# California Univ., Los Angeles. Dept. of Engineering.
OPTIMAL CONTROL OF DISTRIBUTED PARAMETER SYSTEMS UDING MULTILEVEL TECHNIQUES
David Arthur Wismer, Jr. Nov. 1966 130 p refs
(Contract DA-04-495-AMC-746(Z))
(Rept.-66-55B; AD-646096) CFSTI: HC$3.00/MF$0.65

The (approximate) solution of optimal control problems involving partial differential equations is studied by discretizing the space domain and considering the resultant set of ordinary differential equations. This approach is certainly not new. However, earlier efforts along this path have been hampered by the difficulties involved in solving the optimal control problem for the very large sets of interacting ordinary differential equations which arise as the discretization interval is decreased. This dissertation suggests the use of multilevel control techniques to overcome this computational difficulty. The major conclusion stemming from this research is that the multilevel approach does appear feasible in solving the optimal control problem for certain classes of distributed parameter systems; namely, linear and nonlinear parabolic or elliptic equations. The convergence properties of the second-level controller are of paramount importance in accomplishing this task. Of the three types of second-level controllers discussed here (feasible, nonfeasible, and Gauss-Seidel), the only one considered suitable in this application is the Gauss-Seidel controller. It is extremely simple and was found to have good convergence properties for this type of problem. In particular, the systems of semidiscrete equations may become very large and the number of subsystems likewise. By its very nature, the performance of the Gauss-Seidel controller does not seem to be degraded by increasing the number of subsystems as long as the discretization interval is not too small. The reason for the good convergence properties observed for this controller is largely the tridiagonal form of the A sub j matrix. TAB

N67-23112# California Univ., Los Angeles. Dept. of Engineering.
OPTIMAL CONTROL OF TWO DISTRIBUTED PARAMETER SYSTEMS
W. H. Yonkin Dec. 1966 117 p refs
(Contract DA-04-495-AMC-746(Z))
(Rept.-66-64; AD-646097) CFSTI: HC$3.00/MF$0.65

The intent of the thesis is twofold. The primary purpose is to present a practical, if heuristic, approach to controlling in an optimal manner a distributed parameter regulator system. The

second objective involved obtaining an optimal control law for the STEM Elevated Camera System. Unfortunately, the eigen-function expansion-Galerkin technique became so involved that insufficient time was available to obtain even the closed loop roots of the controlled system. Had the roots been obtained considerable work would have remained to obtain the complete form of the optimal control law. The bright point concerning the STEM involves the discretization method. The validity of the approach is demonstrated on the wave test case. The practicability of the discretization technique is demonstrated by its application to the STEM problem. This approach produced closed loop roots, a displacement time history, and an optimal control law. TAB

N67-23151# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.

CHARACTERIZATION OF CERTAIN POLYFUNCTIONAL SWITCHING NET STRUCTURES

John F. Boudreau Sep. 1966 51 p refs *Its* Phys. and Mathematical Sci. Res. Papers No. 260

(AFCRL-66-632; AD-646255) CFSTI: HC $3.00/MF $0.65

Sets of net functions are characterized and enumerated for several classes of nets composed of elements which perform an arbitrary Boolean function of their respective inputs. The nets considered are: chains of mX1 elements (having m inputs and one output), symmetric and general trees of 2X1 elements, and cascade nets (each stage of which is composed of both a 2X1 element and an mX1 net). For each class of nets, production systems are given which generate representations of the realizable functions and facilitate their enumeration. Author (TAB)

N67-23178# Princeton Univ., N. J. Information Sciences and Systems Lab.

ON MINIMUM-MEAN-SQUARED ERROR NONLINEAR FILTERING

A. H. Haddad and J. B. Thomas Aug. 1966 158 p refs

(Contract DA-31-124-ARO-D-292; Grants NSF GP-1647; NSF GK-187)

(TR-16; AROD-5105-15; AD-645744) CFSTI: HC $3.00/MF $0.65

The study is concerned with the minimum-mean-squared error (MMSE) nonlinear filtering of signals in additive noise. Methods of analysis, representation, and classification of non-linear systems are treated. Integral representations and their applicability to random inputs and MMSE filtering are emphasized. The general MMSE nonlinear filtering problem is discussed briefly; the restriction of the filter to general classes of systems or input processes is considered. Usually the general solutions to the problem are difficult and in many cases are impractical; therefore restriction to special classes of systems and special classes of input processes is investigated. Author (TAB)

N67-23368# Texas Univ., Austin.

TRANSISTOR THRESHOLD LOGIC GATES

Roy M. Matney, II and Cyrus O. Harbourt 31 Aug. 1966 65 p refs

(Grant AF AFOSR-766-66)

(TR-23; AD-801358) CFSTI: HC $3.00/MF $0.65

Threshold gates can be built using many types of devices such as transistors, tubes, tunnel diodes, and silicon controlled switches. The transistor threshold gate is studied here because of its small size, low power dissipation and good transition characteristics. The importance of sensitivity depends upon the logical function being realized. Complex functions require a less sensitive gate. State transition speed is limited by saturation and by high impedance levels. Using low impedance current mode gates this limit is reduced. ECAP (Electronic Circuit Analysis Program) is employed in the design of threshold gates. Examples of both saturated and current mode transistor threshold gates are presented and compared. Author (TAB)

N67-23406# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND CONTROL THEORY

G. S. Plesnevich 2 Feb. 1967 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 171, no. 3, 1966 p 537–540

(JPRS-39742; TT-67-30390)

One-dimensional unilateral iterative systems with combinational cells and with delays in lateral channels are considered. The state of an n-network iterative system ϕ at any moment of discrete time is called the totality of states of all lateral channels of the n-network at that moment (including the state of the lateral channel entering the first cell network, and the state of the lateral channel leaving the last cell network). The state of the n-network can conveniently be regarded as a word of length n+1 in the alphabet S, considering the i-th letter of this word to be the lateral signal which is stored in the i-th lateral channel of the n-network. (The numbers assigned to the lateral channels of the network increase in the direction of passage of lateral signals through the network, the first channel being assigned the number 0). Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-21948*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PRODUCTION OF ULTRAHIGH VACUUM WITH A HEATED HYDROGEN CONDENSATION PUMP

E. S. Borovik, G. T. Nikolaev, and B. A. Sharevskii *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 397–401 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Described is the design and performance of a heated vacuum system with a hydrogen condensation pump screened from the walls of the unheated vacuum system by a hydrogen baffle to prevent outgassing. The system was heated electrically by nichrome coils wound externally on special cores surrounding the evacuated volume and the triplet. Experiments showed that the heated pump was able to create an ultimate vacuum of 4 to 5×10^{-8} N/m^2 in clean chambers of several dm^3. The pump speed was 600 dm^3/sec and pumping time to a vacuum of 5×10^{-6} N/m^2 in a 60 dm^3 chamber was 13 to 14 hrs. G.G.

N67-21951*# Israel Program for Scientific Translations, Ltd., Jerusalem.

OPTIMAL PARAMETERS OF THE GVL-2 MAGNETIC MACHINE AND SOME FEATURES OF LOW-TEMPERATURE SOLENOIDS

F. I. Busol, V. A. Kovalenko, E. I. Skibenko, and V. B. Yuferev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 412–418 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Optical parameters of a magnetic machine, having copper solenoids cooled to the boiling point of liquid nitrogen, were calculated for pulsed and continuous operation, and for low-temperature and conventional operation under adiabatic conditions. Considered were the following three operating modes in choosing the coil windings: (1) coil resistance substantially greater than the internal resistance of the source (2) coil resistance equal

to internal resistance of source; and (3) coil resistance smaller than internal resistance of the source. Plots of the calculated fields versus time curves for coils of identical shape with windings representing the above three modes showed that for adiabatic conditions and the existing power source of 1200 V, coils with a resistance smaller than the internal resistance of the source provided the best results. G.G.

N67-21962*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FIRST ANNUAL LOGISTICS MANAGEMENT SYMPOSIUM, SEPTEMBER 13 AND 14, 1966
16 Jan. 1967 126 p
(NASA-TM-X-53566) CFSTI: HC $3.00/MF $0.65 CSCL 05A

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N67-21963*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
KEYNOTE ADDRESS
George E. Mueller *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 8–11 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

A keynote address is presented which focuses on the importance of manned space flight logistics management to furthering programs established to achieve national goals in space. Analyzed are several logistics considerations presently facing Manned Space Flight managers and Apollo contractors among which are cited: (1) the stringent requirements for controlling and reducing program costs; (2) spares management; (3) contingency and logistics planning; (4) the need for cooperative effort between NASA, NASA and its contractors, and the Department of Defense; (5) the need for early considerations of program logistics and contractor duties; and (6) the need for reassessing logistics support concepts based on the needs of new programs, as for example, programs of the post-Apollo era. In view of the magnitude of Apollo's requirements in terms of hardware, facilities, ground support equipment, personnel, and logistics, it is surmised that effective logistics management is indispensable to program success. S.C.W.

N67-21964*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LOGISTICS SUPPORT FOR LAUNCH SITE OPERATIONS
Kurt H. Debus *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 12–17 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

A discussion of logistics support for the Kennedy Space Center launch site operations is presented. Reviewed is the role of logistics in the development of a new mobile launcher concept for the Apollo/Saturn V space vehicles; launch complex; and the selection of Merritt Island as a prime operational base. The importance of logistics to the launch and support functions of the Kennedy Space Center organization is also discussed. Emphasized is the logistics of facilities, ground support equipment, flight hardware, propellants and pressurants, instrumentation and communications, and spare parts for flight hardware and ground equipment. S.C.W.

N67-21965*# Army Research Office, Washington, D. C.
THE US ARMY'S LOGISTICAL SUPPORT OF OPERATIONS IN VIET NAM
Thurston T. Paul *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 18–19 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

A discussion of newly developed installations for handling supplies and equipment arriving via sea and air transportation for support of operations in Viet Nam is presented. Cited are U.S. Army logistical operations which resulted in major improvements to coastal ports at Saigon, Cam Ranh Bay, the Navy-operated port at Da Nang, and Army-operated ports at Qui Nhon, Nha Trang, and Vung Tau. Logistical support operations focusing on the distribution of supplies from the two main wholesale supply centers at Saigon and Cam Ranh Bay and the retail supply centers are cited. Also mentioned is the establishment of a high priority supply operation (Red Ball Express) for handling requests for repair parts. Problems facing the logistics support system as the task of receiving the U.S. forces, furnishing them with supplies, building logistical facilities, and replenishing stocks, are also cited. S.C.W.

N67-21966*# Martin Co., Baltimore, Md.
INTEGRATED LOGISTICS SUPPORT
James L. Carpenter, Jr. *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 22–25 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Presented is a discussion of what constitutes integrated logistic support and why it must be given premium consideration throughout the planning for acquisition of any hardware system. Focused upon are the elements of integrated logistics support, the interaction among the elements of support, and cost, timing, and schedule. Reviewed are logistic support problems and added costs resulting from: (1) a lack of realistic consideration of the total life

cycle for hardware and systems; and (2) the lack of a systematic merger of the elements of support early in the program evolution. Definitions of integrated logistic support, and the elements of integrated logistic support are presented which indicate that emphasis is being placed on the integration of the elements of support and the timing of the support consideration. Efforts of the Department of Defense to improve logistic support planning and implementation are also cited. S.C.W.

N67-21967*# Air Force Systems Command, Washington, D. C.
PRE-PLANNING LOGISTICS SUPPORT
Joseph J. Cody, Jr. *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 26–30 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

The significance of preplanning logistics support and its place in a program schedule is discussed. Analyzed are Air Force Systems Command logistic support responsibilities during acquisition and during operational employment. Emphasized is the role of the systems engineering process in providing a basis for engineering decisions; providing a discipline for maintaining a system perspective across end items and across functional specialities; and establishing a single source of standardized series of engineering reference points or baselines which are based on the progressive and evolutionary development of specifications which, in turn, are forcing function upon design. The importance of documentation generated under the Systems Command, Logistics Command, Training Command, and the using command is also emphasized. Two support planning checklists for use by program managers are cited. S.C.W.

N67-21968*# Bureau of Naval Weapons, Washington, D. C.
THE TECHNICAL PHILOSOPHY OF SUPPORT
John P. Sager *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 31–35 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Discussed is the concept of Naval Air Systems Command technical philosophy of support as related to the methods used to determine, plan, procure, and distribute the total spectrum of logistic support resources in the quantities required, at the time required, and at places where needed so as to operate and maintain weapon systems in a fully configured, combat-ready, mission-capable state of readiness. Focused upon are concepts used to support logistically Naval aircraft aboard ships underway at sea; land-based patrol aircraft from remote advanced bases during time of war; and patrol seaplanes from ships which are designated by the Navy as seaplane tenders. The means by which maintainability requirements are expressed contractually, as for example, through technical development plans and requests for proposals, are analyzed to show how these procedures stipulate firm operational, maintainability, and support requirements. Examples are included to illustrate how Naval support philosophy governs program policy. Also identified are some of the major activities fully engaged in logistic support. S.C.W.

N67-21969*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SCOPING SUPPORT TO PROGRAM REQUIREMENTS
Samuel L. Phillips *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 36–39 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Presented is a discussion on the scoping of logistics support to program requirements which emphasizes the role of the logistician during the conceptual, design, development, and production phases of the system program. Also emphasized is the importance of the field operator's experience in improving system design. The scoping of logistics support for Apollo versus Minuteman is discussed in an attempt to illustrate that both the system itself and the design of the system must be geared to the goal and objective during the early phases of total system planning, and to show that logistics support required for a system is in fact traded off against various final design alternatives existing in the formulation of the system design with the ultimate purpose of the system in view. It is concluded that: (1) the logistician, if properly oriented, makes one of his greatest contributions by participating aggressively in the concept and development phases of the system program; (2) one of the most important tools to enable the correct analysis for tradeoff decisions involving logistics considerations versus other facets of development and performance is a well constructed system functional analysis; (3) an important way to accelerate system maturity for new programs is to have the same equipment, whether it be flight hardware or ground equipment, come from the factory through the field test sites into the operational site with such augmentation of instrumentation as might be required upstream; and (4) the professional logistician needs to become involved in the program engineering phase so that some professional logistics engineering will be introduced in the concept, the design, and the whole development process including testing, production, and deployment since this is where the logistics support requirements are really scoped and where the logistician needs to have his first influence. S.C.W.

N67-21970*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE GROWING NEED FOR LOGISTICS ENGINEERS
Wernher von Braun *In its* 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 42–45 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

The growing need for logistics engineers to support U.S. military operations; the manned and unmanned space programs; and studies focusing on the systematic development of the resources of planet earth to feed future populations are discussed. Emphasized is the lack of formal academic training in the field of logistics at colleges and universities, and on governmental and industrial levels. Proposed is the establishment of a complete educational program designed to produce qualified logistics engineers to meet the increasingly stringent requirements of both government and industry. The following three sets of goals are suggested as possible bases for the proposed program: (1) Short term goals which would provide for interchange of logistics information and know-how as to techniques, advances in the state of the art, and projected new requirements. These objectives could be accomplished through the holding of symposia, seminars, and short courses. (2) Intermediate goals which focus on joint efforts between industry and government agencies to develop specific educational objectives for career development of the logistician; and which might also contain college-level specialized courses. (3) Long term objectives in which college degree programs might be established in logistics, including graduate level courses, based on joint studies with the academic community to define and refine the logistics disciplines into a professional career structure. S.C.W.

N67-21971*# North American Aviation, Inc., El Segundo, Calif.
MANAGEMENT OF LOGISTICS SUPPORT
Sterling B. Smeltzer *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 49–55 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Presented is a discussion of the role of the logistics manager and the controls which affect program success. Focused upon are: the importance of logistics support planning and specific elements which are essential to the effective development and use of a logistics support plan; the contract as a management control; the fundamentals of management controls and their relationship to the logistics success of large programs; exercising limitations; the ultimate contribution of a well planned logistics effort; and challenges of the future in logistics. Key points bearing directly upon logistics management are summarized as follows: (1) Logistics is a prime function and must be organizationally structured to deal on an equal basis with other key functions. (2) Logistics

responds most effectively when its elements are integrated as a single organizational entity. (3) Proper logistics support is dependent upon proper logistics planning and this planning must be accomplished early in the program. (4) Logistics management must accept the challenges presented by new technologies and advanced program requirements. S.C.W.

N67-21972*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE PROGRAM MANAGERS' PROBLEM
Arthur Rudolph *In its* 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 56–60 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Saturn V program management problems resulting from failure to plan for an integrated logistics program during early phases of planning, and improper management visibility of the logistics activities of contractors working on the program are discussed. Joint efforts of the program manager; industry; and ground support equipment, logistics, and project managers to mold the Saturn V logistics program to fit the status of launch vehicle system development and the program budget; and efforts to obtain management visibility; are cited. S.C.W.

N67-21973*# Navy Dept., Washington, D. C.
CONTRACTING FOR LOGISTICS SUPPORT: (GOVERNMENT POSITION)
Joseph L. Howard *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 61–64 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Trends in government contracting and government reliance on industry and the growing complexity of technology are discussed in an attempt to define the governments position in contracting for logistics support. Cited are trends in Department of Defense and Navy policies which illustrate that the government is using weighted guidelines which have specific factors for company contribution and company risk; and that the government is moving in the direction of total package procurement. The degree of risk, from the government's standpoint, resulting from failure to get either what it wanted, or getting the item when needed; and economic risks to contractors in fixed price, incentive-type, or cost or fixed price contracts, are discussed. Inherent problems associated with the structuring of contracts so as to provide assured development, production, and support on time at reasonable cost are also discussed. It is suggested that: (1) The contract must be a finely balanced instrument that contains the right amount of risk for the company, and the right amount of incentive reward, to give the company the necessary motivation to succeed in performing the contract; and (2) The government must have a contract that it gives reasonable confidence that the right quality will be delivered on time at reasonable cost. S.C.W.

N67-21974*# National Aeronautics and Space Administration, Washington, D. C.
CONTRACTING FOR LOGISTICS SUPPORT: (NASA POSITION)
George J. Vecchietti *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 65–67 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Presented is a discussion of NASA's efforts to place logistics support planning and execution on the same plane of importance as that of the end item hardware or service. The following are specified steps in this direction: (1) The incorporation of logistics support requirements in project approval documents which include definitive cost estimates; (2) The incorporation into procurement plans of a requirement for even more definitive discussion and planning on logistics support aspects; (3) Revised source evaluation and selection procedures which will include significant weighting on the realism, definitiveness, and effectiveness of logistics support plans set forth in industry proposals; and plans which will play an appropriate part in evaluating contractors' proposals in a competitive atmosphere; and (4) The incorporation into phased project planning provision for orderly transition from initial logistics support concepts to a high degree of preciseness in the sequential contract phases that follow. NASA's plans to use the award fee concept in contracting for logistics support are also discussed. S.C.W.

N67-21975*# Boeing Co., Seattle, Wash.
CONTRACTING FOR LOGISTICS SUPPORT: (INDUSTRY POSITION)
Stanley C. Hellman *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 68–70 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

The principles of management planning for industry–government contracts are outlined. General characteristics of logistics contracts are discussed, including: (1) work statements; (2) program costs; (3) types of contract; (4) management control; (5) procurement concepts; and (6) contractor incentives. K.W.

N67-21976*# McDonnell Aircraft Corp., St. Louis, Mo.
MEASURING LOGISTICS PERFORMANCE
John F. Sutherland *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 71–72 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

The various organizational levels for evaluating the performance of logistics contractors are indicated. The effects of planning, funding, and budgeting on performance are briefly discussed. K.W.

N67-21977*# Aviation Supply Office, Philadelphia, Pa.
EVALUATION IMPLEMENTATION
H. J. P. Foley, Jr. *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 73–74 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Described is the evaluation of logistic support by contractors as performed in the U.S. Navy Aviation Supply Office. The focus is on initial support for aircraft spares and special support equipment. Navy–contractor coordination in controlling a program is explained, and problems of time schedules and funding are mentioned. The role of automated data processing and improvements in management methods are also covered. K.W.

N67-21978*# Army Missile Command, Huntsville, Ala.
VISIBILITY FOR EVALUATION
John G. Zierdt *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 75–77 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

An evaluation of logistics planning, contracting, and operation from the point of view of management is given. Emphasized are logistics in the U.S. Army missile branch. The role of logistics and its evaluation during all phases of a system program, from research and development through maintenance in the field, is traced. Managerial methods and tools for control and evaluation of logistics are discussed, and several examples of application are included. K.W.

N67-21979*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SUPPORT VERSUS TOTAL PROGRAM EVALUATION
Forrest E. Waller *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 78–79 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

Covered are management practices, system analysis techniques, and procedures for acquiring, tracking, and measuring logistics performance consistent with overall program schedule requirements. The need for early planning in logistics management in relation to

total program objectives is stressed. Development of methods for measuring logistics actions in several NASA programs is mentioned. K.W.

N67-21980*# Ballistic Systems Div., Norton AFB, Calif.
PROCUREMENT EVALUATION
John L. McCoy *In* NASA, Marshall Space Flight Center 1st Ann. Logistics Management Symp. 16 Jan. 1967 p 80–81 (See N67-21962 11-11) CFSTI: HC $3.00/MF $0.65

The measuring of logistics performance through the procurement process is discussed using examples from the Air Force's Minuteman Program. The effect of incentive features on logistics planning is reviewed, and integration of logistics engineering elements with total program requirements and management is briefly covered. K.W.

N67-22134# Aerodynamische Versuchsanstalt, Goettingen (West Germany). Abteilung Raumfahrt-Aerodynamik.
THE HYPERSONIC LOW DENSITY WIND TUNNEL OF THE AERODYNAMISCHE VERSUCHSANSTALT GOETTINGEN—OPERATIONAL BEHAVIOUR AND FIRST RESULTS ON REAL GAS EFFECTS IN NOZZLE FLOWS [DER HYPERSONISCHE VAKUUMWINDKANAL DER AERODYNAMISCHEN VERSUCHSANSTALT GOETTINGEN—BETRIEBSVERHALTEN UND ERSTE ERGEBNISSE UEBER REALE GASEFFEKTE IN DUESENSTROEMUNGEN]
G. Koppenwallner Sep. 1966 39 p refs In GERMAN; ENGLISH summary Presented at DGRR/WGLR Ann. Meeting, Bad Godesberg, West Germany, 4–8 Oct. 1966 Supported in part by Bundesministeriums fuer Wiss. Forsch.
(DLR-FB-66-62; AVA-FB-6612) CFSTI: HC $3.00/MF $0.65

At the Aerodynamische Versuchsanstalt Göttingen a Hypersonic Low Density Wind Tunnel, designed for Mach numbers between 12 and 24 and stagnation temperatures up to 3000°K, has been taken in operation. After a short description of this wind tunnel a report on the first measurements in this wind tunnel is given. The measurements have been made in a Mach number range between $Ma_\infty = 19$ and 24 and at stagnation temperatures up to 2500°K at stagnation pressures between 30 and 200 ata. In these tests the influence of stagnation pressure p_0 and stagnation temperature T_0 on the static pressure distribution along the nozzle, on the Mach number distribution in the test section, on the diffusor pressure recovery and on the condensation of the gas is examined. Author

N67-22141*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIOMETRY RESEARCH
Feb. 1967 327 p refs
(NASA-TM-X-55735; X-713-67-73) CFSTI: HC $3.00/MF $0.65 CSCL 14B

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7. ELECTRO-MAGNETIC MEASUREMENTS GROUP, PART II R. McIntosh 135 p refs (See N67-22148 11-11)
8. SOLAR CELL CALIBRATION EVALUATION Quarterly Report, Sep.–Nov. 1966 W. G. Gdula 55 p (See N67-22149 11-03)

N67-22142*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR SIMULATION STUDIES Summary
In its Radiometry Res. Mar. 1967 5 p (See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65

A summary is presented of accomplishments related to solar simulation studies in the following areas: (1) paint testing, (2) planning for high altitude tests of solar spectral irradiance, (3) progress in developing a pressure arc system and a vortex stabilized radiation system, (4) testing of thermal control coatings, and (5) solar cell calibration. C.T.C.

N67-22147*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL LABORATORY REPORT
M. Lillywhite *In its* Radiometry Res. Mar. 1967 60 p ref (See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65

Recent developments in solar simulation techniques are discussed. These developments include uniformity filtering, spectral filtering, and improved spectral matching using krypton and xenon lamps. The problems involved in using these components are discussed along with the consequent modifications necessary to the A 1200 solar simulator. Early results are presented from a study that evaluates solar simulation anomalies experienced when different sources and techniques are used. Spectral irradiance data of various sources are given and coatings degradation data using these different sources are compared. The general problem of maintaining the spectral and total irradiance of a solar simulation system during coatings testing is discussed. Author

N67-22148*# Electro-Mechanical Research, Inc., Sarasota, Fla.
ELECTRO-MAGNETIC MEASUREMENTS GROUP, PART II
Roy McIntosh *In* NASA. Goddard Space Flight Center Radiometry Res. Mar. 1967 135 p refs (See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65
(Contract NAS5-9244)

This report describes the solar simulation effort in a satellite thermal control coating program. Subjects discussed are the vortex stabilized arc, a pressure arc facility, spectral irradiance measurements of various light sources, and an ultrahigh vacuum system used in support of simulation testing. The computer programming techniques for this simulation effort are described. Author

N67-22150*# Stanford Research Inst., Menlo Park, Calif.
FEASIBILITY STUDY OF AN EXPLOSIVE GUN
John K. Crosby and Stephen P. Gill Washington, NASA, Apr. 1967 102 p refs
(Contract NAS2-1381)
(NASA-CR-709) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The components required for a gun with near-optimum performance were specified as (1) low detonation velocity in the first stages to allow the use of a short, high pressure helium reservoir; (2) a transition section around the original projectile position to allow containment of high pressures during the low velocity stages of projectile acceleration; and (3) detonation velocities increasing gradually to very high values as the acceleration proceeds. The experimental work performed on these three problems is discussed, along with experiments on a constant velocity–constant wall thickness gun using thin-walled, high strength steel tubing. Different modes of gun operation were studied using the artificial viscosity computer code. A theoretical design of an explosive system, which will provide a piston with constant acceleration, is proposed. Theoretical calculations are presented on ionization, radiative cooling, and boundary layer effects along with calculations on the NASA–Ames 4"–1" deformable piston light gas gun. It was concluded that the gun operation was experimentally demonstrated, and that fair agreement between theoretical and experimental performance was shown. M.G.J.

N67-22207# Israel Program for Scientific Translations, Ltd., Jerusalem.
POWER-ENGINEERING INSTALLATIONS OF THE 500 KV VOLGA POWER PLANTS
G. R. Ogul'nik *In its* 500 KV Long-Distance Electric Transmission 1966 p 431–448 refs (See N67-22181 11-09) CFSTI: HC $3.00/MF $0.65

Details of the main installations and equipment of the Kuibyshev and Volgograd hydroelectric power plants located on the Volga River are described. Layouts, cross sections, circuit diagrams, and photographs are included. R.N.A.

N67-22308# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
AN AUTOMATIC SYSTEM FOR THE PREPARATION OF CULTURE MEDIA
Raymond S. Harvey Nov. 1966 8 p
(Contract AT(07-2)-1)
(DP-1081) CFSTI: HC $3.00/MF $0.65

An automatic system was developed to reduce the manpower and laboratory space required for the preparation and storage of synthetic media for long-term continuous flow studies with mass cultures of algae. This equipment was designed to supply culture media containing radionuclides for tracer studies with algae; however, it can be easily modified to continuously supply a variety of solutions for laboratory investigations. This system is compact, accurate, and requires little maintenance. Author (NSA)

N67-22331# Sandia Corp., Livermore, Calif.
EVALUATION OF THE MIDGET IMPINGER FOR SAMPLING U_3O_8 AND GRAPHITE AEROSOLS
R. J. Everett and S. Posner (Lovelace Found. for Med. Educ. and Res.) Oct. 1966 16 p refs
(Contract AT(29-1)-789)
(SC-RR-66-597; LF-32) CFSTI: HC $3.00/MF $0.65

Pyrolytic graphite and U_3O_8 dust distributions were prepared and aerosolized into a chamber equipped with balancing flow sampling ports. Aerosol samples were taken by standard midget impingers and Millipore type AA membrane filters. Particle size distributions were determined. From these data, comparisons were made to evaluate fracturing of particles by impingement, cluster breakdown, effects of sampling solutions, and the effect of ultrasound used to keep samples in suspension. Results indicate the existence of a critical time factor for counting the dust; this factor is caused by the breakdown of pyrolytic graphite particle clusters in solution. No significant fracturing due to impingement or ultrasonic stirring was observed. Ultrasonic agitation tends to accelerate the breakdown process in pyrolytic graphite suspensions. Author (NSA)

N67-22332# Union Carbide Nuclear Co., Oak Ridge, Tenn.
MIXING AND SAMPLING ENRICHED U-235 FLUIDS IN CYLINDRICAL STORAGE CONTAINERS Final Report
J. E. Harrell 17 Jan. 1966 124 p refs
(Contract W-7405-ENG-26)
(Y-1561) CFSTI: HC $3.00/MF $0.65

A study was performed that combined the measurement of some safe-tank mixing and sampling characteristics with a theoretical analysis for the generalization of mixing characteristics for recirculation in mixed-tank systems. Safe-tank mixing was simulated in an experimental facility that consisted of both horizontally and vertically oriented tankage that was equipped with flow-rate and fluid-concentration measurement components. Both single and parallel tanks were used. Fluid was mixed in the horizontal systems by recirculation and in the vertical tanks by air sparging. The mixing time required to disperse and mix a relatively small volume of tracer with the bulk fluid was measured. This mixing time was correlated with the flow rate. For single-tank systems, dispersion-intensity data were collected. Both mixing-time and dispersion-intensity data were found to fit reasonably well into a full logarithmic plot as a function of the recirculation rate by linear correlation. The theoretical treatment utilized a combination of the tanks-in-series model and the dispersion model, and required either analog or digital-computer solutions. For single-tank systems a generalized and dimensionless solution for mixing-time prediction was obtained and plotted. A similar treatment was made for parallel-tank systems, but a solution to this complex problem cannot be presented as simply. However, an alternate scheme for predicting the upper limit of parallel-tank mixing time using the single-tank solution has been developed. Guidelines for mixing miscible fluids or mixing miscible fluids containing fine solids prior to representative sampling have been established. The effect of the piping arrangement of the various tankage systems upon mixing, sampling, and fuel-inventory uncertainties has been studied and recommendations made for the design and operation of a tankage system. Author (NSA)

N67-22337# Los Alamos Scientific Lab., N. Mex.
THE MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, for Period Ending Oct. 31, 1966
30 Nov. 1966 71 p refs
(Contract W-7405-ENG-36)
(LA-3624-MS) CFSTI: HC $3.00/MF $0.65

The medium-energy physics program at LASL which deals with the new Los Alamos Meson Physics Facility is discussed. The topics considered are progress of the 800 MeV proton linac especially in the accelerator structures, rf power sources, control and instrumentation, accelerator physics, and project scheduling and facilities planning. NSA

N67-22392# Kaman Aircraft Corp., Bloomfield, Conn.
FEASIBILITY STUDY OF AIR BEARING ROCKET SLED SLIPPERS Final Report, Feb. 16–Jul. 1, 1966
R. C. Meier and A. F. Smith Holloman AFB, N. Mex., Jul. 1966 123 p refs
(Contract AF 29(600)-5516)
(R-638; MDC-TR-66-110; AD-643756) CFSTI: HC $3.00/MF $0.65

A study was conducted to investigate the feasibility of applying the principle of air film lubrication to rocket sled slippers to: (1) overcome erosive oxidation and severe melting effects experienced at hypersonic speeds and (2) alleviate rail-induced vibrations. Results of the study indicate that a simple self-acting type of bearing can support a typical monorail rocket sled, without contact between the slipper and the rail, at speeds between Mach 1.5 and Mach 6. With contact eliminated, the slipper can be coated with a refractory material to prevent erosive oxidation and melting of slipper structural material. This type of air bearing slipper appears to be the most suitable for AFMDC requirements. An externally pressurized type of slipper bearing is capable of preventing slipper-rail contact over the entire speed range of typical monorail and dual rail sleds. However, the weight and volume of the associated pressurization system are large, and are considered prohibitive for a practical design. The most critical track requirements for an application of air lubricated slippers are the vertical alignment and dimensional tolerances of the rail. Author (TAB)

N67-22462 British Hydromechanics Research Association, Cranfield (England).
A BIBLIOGRAPHY ON SIPHONS AND SIPHON SPILLWAYS
T. E. Brock and A. L. King, comp. Mar. 1966 30 p refs
(BIB-21)

The bibliography contains references to books and journals. Several entries have abstracts included. N.E.N.

N67-22500# European Space Technology Center, Noordwijk (Netherlands).
SPACE ENVIRONMENTS: THEIR EFFECTS ON SPACECRAFT DESIGN
S. L. Entres Paris, ESRO, Nov. 1966 23 p Presented at the ESRO Summer School, Oxford, 12 Aug. 1964
(ESRO-TM-47) CFSTI: HC $3.00/MF $0.65

The space environments of major importance in spacecraft design are considered from the point of view of the technical problems presented. The effects these environments produce on a spacecraft in orbit are discussed in some detail. The problems of laboratory simulation of these space environments are considered; in particular, the combination of vacuum, the heat sink of space, and thermal radiation sources. Methods of simulating weightlessness are described. Author (ESRO)

N67-22503# European Space Technology Center, Noordwijk (Netherlands).
VACUUM CONDITIONS AND THEIR ATTAINMENT IN THE LABORATORY
J. H. Makkink Paris, ESRO, Nov. 1966 78 p refs Presented at the ESRO Summer School, Oxford, 12 Aug. 1964
(ESRO-TM-48) CFSTI: HC $3.00/MF $0.65

The basic theory underlying the subject is gone into in some detail, and equations are given relating to the velocity distribution, mean free path, and diffusion of gases. Absorption, desorption, and diffusion phenomena are discussed in relation to materials used in spacecraft. Reference is made to obtaining very low pressures by means of materials of high absorptivity, such as carbon (physical absorption), and by the use of getters (chemical absorption). Various pumping systems are then described, in particular, oil diffusion pumps, for which the general pumping formula is given. A survey of a few pressure-measuring devices follows, including methods of measuring total and partial pressures. The paper ends with description of various methods of leak detection. Author (ESRO)

N67-22554# Environmental Science Services Administration, Atlantic City, N. J. Test and Evaluation Lab.
AN ANALYSIS OF RUNWAY VISUAL RANGE
Ernest E. Schlatter Mar. 1966 38 p refs
(SRDS-RD-66-24; AD-645333) CFSTI: HC $3.00/MF $0.65

The results of a controlled observational program have been compared to Runway Visual Range values. A mobile laboratory was positioned on the touchdown point of an instrument runway during low visibility conditions. Observers were stationed on top of the vehicle to make RVR observations. The high intensity runway edge lights were counted under various light intensity settings and illumination conditions. Simultaneous measurements of atmospheric transmittance provided RVR values. Interim results are based on observations made at NAFEC airport only. They indicate that day RVR values are conservative and night RVR values are representative of static observations made of the high intensity runway edge lights. TAB

N67-22608# Princeton Univ., N. J.
GENERAL DESCRIPTION OF THE PRINCETON DYNAMIC MODEL TRACK
H. C. Curtiss, Jr., W. F. Putman, and J. J. Traybar Nov. 1966 31 p refs
(Contract DA-44-177-AMC-8(T))
(USAAVLABS-TR-66-73; Rept.-738; AD-645883) CFSTI: HC $3.00/MF $0.65

The Princeton Dynamic Model Track is a facility which consists of a servocontrolled hydraulically powered model carriage mounted on a monorail track. The track is housed inside a 30-by-30-foot building 750 feet long. The carriage contains a model mount designed to allow the carriage to follow the powered model without imposing restraints on the model motions being studied. From one to five degrees of freedom motions can be examined, both longitudinal and lateral-directional, in or out of ground effect. The Dynamic Model Track can provide static and dynamic derivative data (e.g., velocity and rate-dependent aerodynamic stability and control derivatives) on V/STOL aircraft models or components in and near hover, slow speed flight, and during transition. In addition, it can provide an experimental simulation of the expected full-scale vehicle control-fixed dynamic motions. Author (TAB)

N67-22732# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.
PHOTOMETRIC DETECTION CONSTRAST OF AIRPORT LIGHTING IN DECREASING VISIBILITY Final Report
D. M. Finch, R. Horonjeff, and H. G. Pauls Aug. 1966 31 p refs
(Contract FAA-ARDS-434)
(SRDS-RD-66-47; AD-645116) CFSTI: HC $3.00/MF $0.65

A photometric method is described for determining the visibility of airport runway lights under various conditions of visual range and background brightness. The method is based on measurement of a defined quantity, Cd, called photometer detection contrast, and depends on the correlation of this quantity with subjective visibility. Use of the photometric method is illustrated by tests conducted in the FAA Fog Chamber. Values of Cd were calculated from luminance scans of runway lights in daytime and nighttime visual ranges of 1600, 1200, and 800 ft. Maximum visibility distances for the lights were then determined by assuming a trial value of .06 as the minimum usable Cd for subjective visibility under the various fog conditions. An automatic scanner mechanism used with a telephotometer for the efficient acquisition of the luminance data is also described. TAB

N67-22774*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECTRAL IRRADIANCE MEASUREMENTS ON SOLAR SIMULATOR SOURCES
Sandra Read and Matthew P. Thekaekara *In its* 1966 Session of the Goddard Summer Workshop [1967] p 447-461 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Spectral irradiance measurement results made on the mercury-xenon lamps are compared with results of similar measurements made on the high pressure xenon arcs. The xenon arc filtered by a suitable interference filter affords a close spectral match to the solar spectrum existing outside the earth's atmosphere. Results of the analysis of the data by the manual program using the CDC 3100 computer show that the spectral distribution of the lamps varies very little from one lamp to another. It is also seen that the spectral match to the sun is rather poor unless the energy is integrated over fairly wide wavelength ranges, but this is no serious drawback since most absorbing surfaces effectively perform this integration. R.L.I.

N67-22776*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHOTON FLUX OF SUBSTANDARD QUARTZ-IODINE LAMPS IN THE RANGE 2500A TO 8000A
Paul Schoen and Jeselle Mayes *In its* 1966 Session of the Goddard Summer Workshop [1967] p 463-466 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Two different procedures were tried for calibrating secondary lamp standards. SW 100 and SW 101, against primary standards EPI 1045, and EPI 1048. Both the standard and the substandard lamps used were 1000 watt "Quartz-iodine" coiled-coil tungsten lamps. The spectral irradiance values of the standards are given in microwatts/cm^2.10A bandwidth vs. wavelength for the source placed 50 cm from the detector. The photon flux was then calculated. Data were taken from the recorder printouts at 50A

intervals from 2500A to 8000A. These successive data runs were made on each secondary lamp, followed by three successive runs on the primary lamp with which it is being compared. The first procedure did not yield consistent results; the second was more satisfactory. R.Ll.

N67-22783# Royal Aircraft Establishment, Farnborough (England).
THE STABILITY OF A WIND TUNNEL MODEL ON FLEXIBLE SUPPORTS
W. G. Molyneux Feb. 1964 38 p refs Presented at the Von Karman Inst. for Fluid Dyn., Belgium, May 1964
(RAE-TN-STRUCT-348) CFSTI: HC $3.00/MF $0.65

The problem of achieving stability in the rigid body modes for a flexibly supported wind tunnel model is considered. Some general design rules for the avoidance of instabilities are presented. Author

N67-22896# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
INTERNATIONAL SYMPOSIUM OF ELECTRON AND POSITRON STORAGE RINGS, PART I
15 Nov. 1966 24 p refs Symp. held at Saclay, France, Sep. 1966 *Its* Nota Interna No. 336
(LNF-66/55) CFSTI: HC $3.00/MF $0.65

Some papers presented at the International Symposium on Electron and Positron Storage Rings are summarized. Storage ring data, injection optics and pulsed inflector, the magnet and its power supply, and vacuum and radio frequency systems are discussed for the Adone project. A method of finite differences is used to interpret the instability of intense electron beam and radio frequency system in a storage ring. Increase in the longitudinal dimension of a relativistic bunch due to coherent-radiation force is treated; and remarks are included on multiple coulomb scattering in a relativistic electron beam, beam size, and beam lifetime. M.W.R.

N67-22914 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
PROTOTYPE OF THE INDUCTION-COUPLED PLASMA TORCH [PROTOTYPE PLAZMOTRONU INDUKCYJNEGO WIELKIEJ CZESTOTILIWOSCI]
B. Lewandowski 1966 34 p refs In POLISH; ENGLISH summary
(INR-738/XVIII/PP) CFSTI: HC $3.00

A description is given of the design of an induction coupled plasma torch. The operating parameters and thermal characteristics of the torch, which has a water cooled chamber, are presented. The high frequency supply unit is also described. The plasma torch has been applied to investigate the powder-spheroidization processes of materials used in reactor fuel technology. Author

N67-22934# Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronen Physik.
NEUTRON CONDUCTORS—A REPORT ON THE CURRENT STATE OF DEVELOPMENT [NEUTRONENLEITER—EIN BERICHT UEBER DEN DERZEITIGEN STAND DER ENTWICKLUNG]
B. Alefeld, J. Christ, D. Kukla, R. Scherm, and W. Schmatz Aug. 1965 54 p refs In GERMAN Prepared Jointly with Tech. Hochschule Munchen
(JUL-294-NP) CFSTI: HC $3.00/MF $0.65

The theory of neutron conductors is reviewed, and loss factors resulting from construction faults are analyzed. A summary of structural requirements of long neutron conductors is followed by a brief discussion of measurements to determine angular deflection and macroscopic unevenness in surfaces. It is concluded that neutron conductors are best suited as beam tubes for neutrons of the wavelength $\lambda = 4$ Å and greater, and they are still advantageous in the range from 0.5 to 2 Å for experiments with good angular resolution. Double-knee neutron conductors offer minimum losses (30%) in diffraction experiments with 2 Å to 4 Å neutrons. Transl. by K.W.

N67-23017# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
FABRICATION OF A SPARK CHAMBER WITH MAGNETOSTRICTIVE WIRE FOR USE WITH A PARTICLE ODOSCOPE [REALIZZAZIONE DI UNA CAMERA A SCINTILLE CON FILO MAGNETO STRITTIVO DA USARE COME ODOSCOPIO DI PARTICELLE]
C. Guaraldo, C. Mancini, P. Picozza, C. Schaerf, and R. Schrimaglio 9 Dec. 1966 10 p refs In ITALIAN *Its* Nota Interna No. 339
(LNF-66/62) CFSTI: HC $3.00/MF $0.65

A plexiglass spark chamber filled with helium gas created a spark gap of 3000 V. Experimental results obtained were satisfactory for the intended magnetostrictive chamber utilization. A retardation effect was noticed, but no variation was seen in the speed of magnetostrictive deformation in the temperature interval between 10° and 35°C. Furthermore, no variations in speed were noticed with a variation of mechanical tension applied at the wire within experimental limits. The spark gap in the spark chamber caused a tension impulse with a retardation effect on the trigger impulse. Transl. by R.Ll.

N67-23058# Bell Helicopter Co., Fort Worth, Tex.
JANAIR: JOINT ARMY NAVY AIRCRAFT INSTRUMENTATION RESEARCH Final Technical Report, May 1, 1964–Feb. 28, 1966
Dora J. Dougherty Feb. 1966 41 p refs
(Contract Nonr-4429(00))
(D228-100-011; AD-645492) CFSTI: HC $3.00/MF $0.65

The simulator studies were oriented about improvement and information augmentation of the contact analog. They were performed in the JANAIR/Bell Dynamic Flight Simulator and examined pilot performance as a function of: (1) the use of director symbols and changes in grid texture, (2) presentation of flight information on vertical tapes, (3) the use of digital readout of flight information. Flight studies examined the Spectocom Head-Up Display and television in flight situations in the JANAIR research helicopter. Recommendations for solution to these problems are presented in the correspondingly appropriate technical reports. Technical reports of all researches performed under the contract have been issued and are reviewed in this document. Author (TAB)

N67-23160# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
FREQUENCY SPECTRUM METHOD FOR ANALYZING GROUND-MOTION DATA PRODUCED BY SINGLE AND MULTIPLE VIBRATORY SOURCES
Robert F. Ballard, Jr. and Roy E. Leach Dec. 1966 76 p *Its* Misc. Paper No. 4-859
(AD-645479) CFSTI: HC $3.00/MF $0.65

Tests were conducted to investigate controlled single and multiple source vibrations induced in an earth media with the primary objective of evaluating the benefits afforded by two data reduction techniques in identifying the frequency and amplitude composition of the ground motion at selected locations. Single signals of known frequency and force level were induced to the ground surface by three types of vibrators mounted on a 10-ft-diameter concrete base. The resultant particle velocities were measured triaxially at each of four locations: on the base and 15, 35, and 90 ft from the base. After the single source tests, the vibrators were operated simultaneously as a multiple signal source input. Data were again recorded at the same locations. Special tests were then performed with two electrodynamic vibrators on the ground surface operating both singly and simultaneously. Results

indicate conclusively that highly accurate correlations can be made. The test results also showed that correlations between known input signals from single sources can be directly compared with multiple signals at corresponding frequencies and force levels.
Author (TAB)

N67-23204# Oak Ridge National Lab., Tenn.
SIMPLE ION SOURCE FOR THE PRODUCTION OF NEGATIVE IONS
H. Dodeck and H. Neuert [1966] 9 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 21A, 1966 p 780–783
(ORNL-TR-1423) CFSTI: HC $3.00/MF $0.65

A simple ion source for negative ions is described with which currents of up to 20 μA (O^-, S^-, Cl^-, F^-, C_2H^-) were measured in continuous operation.
NSA

N67-23234# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
AN IMPROVED SHEATHED ELECTRIC HEATER
J. A. Quarrington and G. A. Wikhammer Jul. 1966 14 p refs
(AECL-2592; PE-16)

Heaters were designed and built to give a surface heat flux in excess of 300 watts per square centimeter (ca. 1,000,000 BTU/sq.ft/hr). Heaters were designed to produce a high, uniform thermal conductance. Precision assembly techniques ensure concentricity between the heater spiral and the metal sheath with minimum insulation thickness. High density boron nitride is used for electrical insulation; the high thermal conductivity of this material results in a relatively low heater spiral temperature. Methods of construction are also described.
Author (NSA)

N67-23357# ARO, Inc., Arnold Air Force Station, Tenn.
RECENT DEVELOPMENTS IN HEAT-TRANSFER-RATE, PRESSURE, AND FORCE MEASUREMENTS FOR HOT SHOT TUNNELS
R. L. Ledford, W. E. Smotherman, and C. T. Kidd Jan. 1967 32 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-228; AD-645764) CFSTI: HC $3.00/MF $0.65

Heat-transfer rate, pressure, and force are essential parameters which must be measured in the operation of a hotshot wind tunnel. Transducers of the proper size, range, and time response required for making these measurements are not generally available on a commercial basis. Therefore, developmental programs directed towards satisfaction of these measurement requirements were undertaken. As a result of these programs, transducers were developed which enabled these measurements to be made. Recent developments have resulted in measurement capabilities and accuracies which are superior to those of transducers which were developed early in these programs (about 1960). A description of these improved transducers and their performance characteristics is included.
Author (TAB)

N67-23384# European Southern Observatory, Hamburg (West Germany).
ANNUAL REPORT, 1965
[1966] 31 p
CFSTI: HC $3.00/MF $0.65

The ESO facilities in Chile; with headquarters in Santiago and observatory buildings in La Silla are described. A prism astrograph, photometric telescope, spectrographic 1.5 m telescope, a Schmidt telescope, and a 3.5 m telescope will be housed there. A revised budget for 1965 is drawn up, and members of the ESO council and the different ESO committees and working groups are listed.
ESRO

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-21950*# Israel Program for Scientific Translations, Ltd., Jerusalem.
VACUUM IMPROVEMENT NEAR SUPERSONIC GAS JETS IN A CHARGE-EXCHANGE CHAMBER
F. I. Busol, V. B. Yuferov, and E. I. Skibenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 408–412 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Deterioration of the vacuum near supersonic gas jets in a charge-exchange chamber was investigated with respect to nozzle geometry. Results for a CO_2 jet, giving the pressure in the charge-exchange chamber as a function of nozzle discharge under various conditions, showed that the deterioration of the vacuum was caused by impurities that did not condense at a particular temperature, and also to CO_2 molecules which reached the tube without colliding with the condenser or baffle after several reflections from the warm walls. Baffling of the nozzle by a copper tube substantially improved the vacuum by screening off the scattered flux from the nozzle, and by partially eliminating the scattered flux produced by interparticle collisions in jet sections near the nozzle.
G.G.

N67-22040*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FREE-MOLECULE FLOW AND SURFACE DIFFUSION THROUGH SLOTS AND TUBES A Summary
Thaine W. Reynolds and Edward A. Richley Washington, NASA, Apr. 1967 105 p refs
(NASA-TR-R-255) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Free-molecule gas flow through tubes and two-dimensional slots were analyzed, assuming diffuse reemission from the walls. For the parallel-walled slots and cylindrical tube models effects of both free-molecule flow and surface diffusion are summarized and the pertinent integral equations developed from classical kinetic theory and various transmission factors are included. Numerical solutions were obtained by using an IBM 7094 computer and are given specifically for slot length-to-width ratios of from 1/4 to 8 and for tube length-to-radius ratios from 1/16 to 16, with wall half-angles ranging from 75° to −60°. The combined flow model that includes gas-phase flow and surface diffusion is described, and general solutions for flow through the slot or tube are discussed. Gas-phase flow distributions, both radial and plane downstream of the exit of the slots are presented for both the near and far fields; and the far-field flux patterns that include the effects of surface diffusion are presented for both parallel-walled slots and cylindrical tubes.
Author

N67-22060*# Israel Program for Scientific Translations, Ltd., Jerusalem.
EXACT SOLUTION OF THE EQUATIONS FOR THE BOUNDARY LAYER OF PSEUDOPLASTIC FLUIDS ON A PERMEABLE FLAT PLATE AND IN THE VICINITY OF THE CRITICAL POINT
B. Berkovskii and Z. Shul'man *In its* Non-Stationary Heat and Mass Transfer 1967 p 126–137 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

The boundary layer hypothesis was found to be applicable and useful for certain classes of non-Newtonian fluids. Exact numerical solutions of the boundary layer equations for noncompressible pseudoplastic fluids on a permeable flat plate and in the vicinity of the critical point are discussed and presented in tabular form.
L.E.W.

N67-22398# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
THE LATERAL INTENSITY OF TURBULENCE AS A FUNCTION OF STABILITY
Frank V. Hansen Nov. 1966 31 p refs
(ECOM-5093; AD-644821) CFSTI: HC $3.00/MF $0.65

The lateral intensity of turbulence with respect to stability was examined. It was found that the intensity of turbulence over an extremely rough nonuniform terrain was greater than over a uniform terrain but that the heterogeneous surface had no other effect on the magnitude of the fluctuations. The stability of the atmosphere was found to have the greatest effect on the lateral component of turbulence with the standard deviation of wind direction being extremely sensitive to changes in stability. The investigation also provided an insight to the variation of the absolute value of the Richardson number with height. Author (TAB)

N67-22445# ARO, Inc., Arnold Air Force Station, Tenn.
HIGH TEMPERATURE, LOW DENSITY BOUNDARY-LAYER CONTROL BY CRYOGENIC PUMPING
W. N. MacDermott, R. E. Dix and J. E. Sheppard Arnold Eng. Develop. Center, Dec. 1966 89 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-177; AD-643963) CFSTI: HC $3.00/MF $0.65

Results are presented of a study of the flow in a hypersonic nozzle operated at low densities and high stagnation enthalpy levels with both natural and controlled boundary layers. The boundary-layer control was established by cryogenic pumping on the nozzle walls, using liquid hydrogen as the cryogen. A flow calibration procedure was evolved for this nozzle which included a fully frozen (in vibration) nitrogen flow model, large low density corrections to pitot and static pressure measurements, and a non-Sutherland viscosity variation. The regimes of isentropic flow in the nozzle were identified by this calibration, and flow conditions within these regimes are given. The boundary-layer control technique permitted the attainment of indicated Knudsen numbers one order of magnitude greater than those produced with no boundary-layer control. At the lowest levels of static density produced in the nozzle with boundary-layer control, evidence of an entropy-increasing process was found which was tentatively identified as a departure from rotational equilibrium in the flow. Author (TAB)

N67-22447# Politecnico di Torino (Italy). Istituto di Meccanica.
THE INTERNAL STRUCTURE OF THE SHOCK WAVE. PART II: MULTICOMPONENT MIXTURES
Gianni Jarre Dec. 1965 32 p refs
(Grant AF-EOAR-63-98)
(AFOSR-66-2596; TN-34; SR-10; AD-643874) CFSTI: HC $3.00/MF $0.65

The diffusional mass flux of each component of a mixture, is explicitly expressed by resorting to a simplified acceptable form of the binary diffusion coefficient. Following the entropic way, the simple Kohler-Dyakov formula is synthetically extended from binary to multicomponent mixtures. The result is that the shock thickness is amplified by the diffusional effects in a multicomponent mixture, but never more so than in the binary mixture composed by the only lightest and heaviest gases. Numerical examples on rare gases are worked out. Author (TAB)

N67-22466# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A GENERALIZED BOUNDARY LAYER CALCULATION TECHNIQUE
H. E. Weber Oct. 1966 51 p refs
(R66SD57; AD-800949) CFSTI: HC $3.00/MF $0.65

Boundary layer behavior in local thermodynamic and chemical equilibrium is predicted and compared with data. The laminar, transition, and turbulent boundary layer is calculated for uniform free stream conditions excluding the effects of free stream turbulence and roughness. Use is made of mixing length and intermittency concepts. A relation between compressible and incompressible mixing length is derived based on experimental observations. Author (TAB)

N67-22502# Southampton Univ. (England). Inst. of Sound and Vibration Research.
SOME EXPERIMENTAL INVESTIGATIONS INTO THE DRAG EFFECTS OF MODIFICATIONS TO THE BLUNT BASE OF A BODY OF REVOLUTION
M. J. Goodyer Jul. 1966 35 p refs
(ISAV-150) CFSTI: HC $3.00/MF $0.65

This is a report on a series of experiments originally begun to find the effects of changes of base-design on the zero incidence drag of a blunt-based body of revolution. The investigations were to cover drag measurements of a long body of revolution with a simple blunt base, a skirted base with and without slits, and a blunt base with aft mounted disc, the measurements being made with both laminar and turbulent boundary layers over a magnetically suspended model. However, some interesting transition wire effects were found, and the scope of the tests was broadened to include a more comprehensive study of the effects of this wire, and to include some measurements of base pressure. ESRO

N67-22510# Ballistic Research Labs., Aberdeen Proving Ground, Md.
INTERFEROMETRIC MEASUREMENT OF THE NONEQUILIBRIUM FLOW FIELD AROUND A CONE
Joseph H. Spurk and Joan M. Bartos Aug. 1966 36 p refs
(BRL-1333; AD-645700) CFSTI: HC $3.00/MF $0.65

Interferometric measurement of the density field around a cone in a stream of oxygen at approximately 10,000 ft/sec is reported. The test flow was generated in an expansion tube, which utilized an unsteady expansion for the purpose of total enthalpy multiplication. The experiment shows that vibrational equilibrium is achieved close behind the shock, while chemical relaxation occurs throughout the shock layer. The experimental density distribution and shock shape are compared with theoretical predictions, and good agreement is found. Author (TAB)

N67-22574# Columbia Univ., New York. Dept. of Electrical Engineering.
AXIALLY DEPENDENT PERTURBATION ANALYSIS USING NONLINEAR PHASE PROGRESSION: MODIFICATIONS AND EXTENSIONS FOR GROSS PERTURBATIONS Interim Scientific Report
S. L. Richter, P. Diament, and S. P. Schlesinger May 1966 83 p refs
(Contracts AF 19(628)-2481; AF 19(628)-5832)
(ISR-92; AFCRL-66-530; AD-645084) CFSTI: HC $3.00/MF $0.65

The iterative perturbation analysis using nonlinear phase progression, previously developed for dealing with axially dependent perturbations on an otherwise axially uniform wave propagating structure, is here modified and extended. One modification of the basic technique readily permits some significant higher order effects of the perturbation to be determined directly from first order calculations. Further modifications drastically reduce the limitations on the size of the perturbation, permitting the corrections to the wave functions to be of even the same order of magnitude as the unperturbed waves. Since the method specifically seeks phase progression factors, it is particularly well suited to electromagnetic propagation problems, especially those which may involve effects strongly dependent upon the phase progression of the perturbed wave. The analysis for gross perturbations given here is therefore applied to situations involving gross dielectric inhomogeneities perturbing an otherwise uniform waveguide and to parasitic traveling wave

antennas. The question of the application of the method to problems involving scatterers from conducting obstacles in waveguides is also discussed. Author (TAB)

N67-22620# Naval Ordnance Test Station, China Lake, Calif.
AN ANALYTICAL APPROACH TO THE TURBULENT MIXING OF COAXIAL JETS
Andrew C. Victor and Rooer W. Buecher Oct. 1966 39 p refs
(NAVWEPS-9057; NOTS-TP-4070; AD-646319) CFSTI: HC $3.00/MF $0.65

The turbulent mixing of coaxial jets is a critical phenomenon in areas such as air-augmented rocket propulsion and radar attenuation by rocket exhausts. In the report a model is developed which approximates the mixing of coaxial jets assuming equal pressures in the two flows. Provision is made for chemical reaction and heat release in the mixing region. The model is based on the theory developed by Libby and assumes that turbulent mixing can be described by the equations for laminar flow, if the laminar transport coefficients are replaced by their turbulent counterparts. The model is demonstrated for an afterburning rocket exhaust, and contours of velocity and temperature in the plume are constructed. Accurate predictions of microwave attenuation and infrared emission by rocket plumes were made on the basis of this model and appropriate thermochemical calculations. A simple computer solution is given. Author (TAB)

N67-22638# Florida Univ., Gainsville. Dept. of Aerospace Engineering.
THE APPROXIMATE INTEGRATION OF THE DIFFERENTIAL EQUATION FOR THE LAMINAR BOUNDARY LAYER [ZUR NAEHERUNGSWEISEN INTEGRATION DER DIFFERENTIAL GLEICHUNGEN DER LAMINAREN GRENZSCHICHT]
Karl Pohlhausen Aug. 1965 43 p refs Transl. into ENGLISH from Z. Angew. Math. Mech. (Berlin), vol. 1, p 252–268
(Contract Nonr-580(14))
(AD-645784) CFSTI: HC $3.00/MF $0.65

One of the more frequently quoted papers in fluid dynamics is the article by Karl Pohlhausen, Zur naherungsweisen Integration der Differentialgleichungen der laminaren Grenzschicht, which appeared on pages 252-268 of Volume I of the Zeitschrift fur angewandte Mathematik und Mechanik. Consequently, it seems appropriate to make an English translation of the original German paper widely available. While the approximate integration technique which the article outlines has been superseded in large measure by substantial improvements, the kernel of all useful methods is given in the original paper. Moreover, many other important results of permanent value to fluid dynamics are presented, e.g., a mathematical derivation of Karmans momentum equation from the boundary layer equation and the mathematical description in finite closed form of the steady two dimensional laminar flow in a converging channel according to boundary layer theory. Author (TAB)

N67-22688# Army Limited War Lab., Aberdeen Proving Ground, Md.
REVISED THEORY OF VORTEX RINGS: A SIMPLIFIED REVIEW OF THE STATE-OF-THE-ART
Serge J. Zaroodny Apr. 1966 74 p refs
(TM-66-01; AD-645931) CFSTI: HC $3.00/MF $0.65

The vortex ring is an essential and ubiquitous phenomenon that has been rather neglected in aerodynamics and technology, perhaps because it is usually construed, unfortunately, as a mere exercise in old-fashioned mathematics. The existing venerable theories of this phenomenon are at once little known, difficult, uncoordinated, insufficient and inconsistent. They are reviewed, modified and combined, and are thus made ready for the long-overdue experimental tests. An essential mathematical preliminary, the theory of straight vortices, is discussed. Author (TAB)

N67-22710# Royal Aircraft Establishment, Farnborough (England).
THE ELECTRIC-SPARK TECHNIQUE APPLIED TO THE MEASUREMENT OF VELOCITY IN LEADING-EDGE VORTEX
P. B. Earnshaw Feb. 1964 12 p refs
(RAE-TN-AERO-2947; AD-441151) CFSTI: HC $3.00/MF $0.65

Because of the unknown accuracy of values of velocity in a leading-edge vortex when these values are deduced from yawmeter measurements, attention has been directed to a possible alternative approach using a tracer technique. It involves the production of a heated, ionized column of air which is convected with the mainstream and is illuminated and reenergized at regular intervals by passing electric discharges through it. Exploratory experiments in a leading-edge vortex show encouraging results, and suggest that further development of the technique should be profitable. Sample measurements of velocity are only 2% to 3% higher than those obtained in earlier work which was done using a five-tube yawmeter head, and to which they therefore offer valuable support. Author

N67-22794# Manchester Univ. (England). Dept. of Mathematics.
ON THE THEORY OF VIBRATIONAL RELAXATION IN GASES
E. Wild Aeronautical Research Council, Mar. 1963 10 p refs Supersedes ARC-24617; see X64-13162
(ARC-CP-725; ARC-24617) CFSTI: HC $3.00/MF $0.65

The effect on vibrational relaxation of terms in the molecular interaction energy which are non-linear in the vibrational co-ordinates is considered. For gases at translational temperatures increases of up to 7% are found in the relaxation frequency between zero excitation and thermal equilibrium. The percentage increase is approximately proportional to the vibrational energy. Author

N67-22797# Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE ESTIMATION OF THE EFFECT OF WIND TUNNEL WALLS ON THE FORCES OF SLOWLY OSCILLATING SLENDER WINGS
W. E. A. Acum Apr. 1963 14 p refs Supersedes NPL-AERO-1014; ARC-24732; see X64-11625
(ARC-CP-707-NPL-AERO-1014; ARC-24732) CFSTI: HC $3.00/MF $0.65

A simple method is described for estimating the tunnel interference effects on the aerodynamic forces on slender wings oscillating with small frequency parameter in subsonic flow in rectangular or circular wind tunnels. Author

N67-22839*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PENETRATION OF DROPS INTO HIGH-VELOCITY AIRSTREAMS
Robert D. Ingebo Washington, NASA, Apr. 1967 17 p refs
(NASA-TM-X-1363) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Drop penetration distances and drop sizes were determined experimentally for crosscurrent injection of isooctane jets into airstreams at a distance of 1 inch downstream from the injector orifice. The results were obtained by photographing the fuel spray with a high-speed camera, and measuring the fuel-air concentration in the spray by a sampling probe technique. Thus, it was possible to relate the maximum penetration distance of the spray to the maximum observed drop size and the ratio of the Reynolds and Weber numbers. Also the point of maximum fuel concentration in the spray was related to the volume-number mean drop diameter and the ratio of the Reynolds and Weber numbers. Results were compared with other data in the literature and agreement was fairly good over a relatively wide range of airstream and liquid-jet injection conditions. In this study, the effect of airstream velocity proved to be considerably greater than the effect of the liquid-jet velocity on drop penetration and drop sizes. Author

N67-22862*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONCENTRATION MEASUREMENTS OF AN INJECTED GAS IN A SUPERSONIC STREAM
Marvin G. Torrence Washington, NASA, Apr. 1967 44 p refs
(NASA-TN-D-3860) CFSTI: HC$3.00/MF$0.65 CSCL 20D

An experimental investigation has been made by using a tracer-gas technique for injected-gas concentration measurements and to obtain preliminary mixing data. The injected gas was a 1% mixture of ethane in air. Mass-fraction concentration (air in air) distributions have been determined and static- and total-pressure measurements have been made downstream of a sonic jet, which issued normal to a supersonic stream from the surface of a flat plate. Surveys were made at axial stations of 7, 15, and 30 jet diameters and at jet- to free-stream total-pressure ratios of 0.34 and 0.60. This experiment was conducted at a free-stream Mach number of 4.03 and a Reynolds number per meter of 7.87×10^7. Stagnation conditions of pressure and temperature were 17 atmospheres and 300°K, respectively. Author

N67-22865*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF INTERFACIAL BEHAVIOR FOLLOWING TERMINATION OF OUTFLOW IN WEIGHTLESSNESS
Lynn S. Brubb and Donald A. Petrash Washington, NASA, Apr. 1967 22 p refs
(NASA-TN-D-3897) CFSTI: HC$3.00/MF$0.65 CSCL 20D

An experimental study was conducted to investigate the behavior of the liquid-vapor interface following termination of outflow from a cylindrical tank in weightlessness. It was found that an axial geyser may occur that can transfer a small amount of liquid to the inlet end of the tank. The occurrence of such a geyser was dependent on Weber number, interface displacement, kinematic viscosity, and the vapor-ingestion phenomenon. Author

N67-22867*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A METHOD OF ASYMPTOTIC EXPANSIONS FOR SINGULAR PERTURBATION PROBLEMS WITH APPLICATION IN VISCOUS FLOW
E. Dale Martin Washington, NASA, Apr. 1967 77 p
(NASA-TN-D-3899) CFSTI: HC$3.00/MF$0.65 CSCL 20D

A method of asymptotic expansions for solving certain classes of singular perturbation problems is presented. The method is a new approach to constructing inner and outer expansions. A classification of singular perturbation problems is given to clarify when this method is applicable and to aid in determination of an appropriate matching rule to use. Simple examples are given to illustrate use of the method. For an important class of boundary-layer-type problems, this approach employs a stronger form of the matching principle than used previously. All displacement effects are retained explicitly in this matching process, and higher order displacements are identified and calculated. The concepts of complex displacement and multiple displacements are introduced. The development of the method leads to clarification of conditions for algebraic or exponential approach of inner to outer expansion solutions. The expansion method is applied to a model of a familiar typical physical problem in viscous-flow theory: hypersonic flow over a sphere. Author

N67-22918# Israel Inst. of Tech., Haifa.
DECAY OF TURBULENT AXISYMMETRICAL FREE FLOWS WITH ROTATION
A. Chervinsky and D. Lorenz [1967] 26 p refs
(TAE-55) CFSTI: HC$3.00/MF$0.65

Previous studies on turbulent swirling jets are extended to cover general axisymmetrical turbulent free flows with rotation, with particular considerations of free jets and wakes. The equations governing the flow are integrated subject to the pertaining boundary conditions making use of the usual boundary layer approximations. The axial and tangential components of velocity are assumed to retain similar forms of radial distributions and a set of two ordinary first order differential equations is derived, the solution of which describes the axial decay of the maximal axial and tangential velocities. Integration of the differential equations in the particular case of uniform external velocity subject to conditions at the orifice results in a set of two second-order algebraic equations which are readily solved. The theoretical solutions derived for a free jet are compared with available experimental results. Author

N67-22955 Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
EFFECT OF LONGITUDINAL SURFACE CURVATURE ON BOUNDARY LAYERS
Roddam Narasimha and S. K. Oiha Sep. 1966 52 p refs
(AE-164-A) CFSTI: HC$3.00

The higher order effect of moderate longitudinal surface curvature on steady, two-dimensional, incompressible laminar boundary layers is considered. The basic partial differential equations for the problem, derived by the method of matched asymptotic expansions, are found to possess similarity solutions for a family of surface curvatures and pressure gradients. The similarity equations obtained by this analysis were solved numerically on a computer, and show a definite decrease in skin friction when the surface has convex curvature in all cases (including zero pressure gradient, for which an approximate asymptotic analysis is also presented). Typical velocity profiles are tabulated. Several reasons for the errors and discrepancies in previous analyses are indicated. Finally, some results are given for flows with arbitrary surface curvature and pressure gradient, using a Pohlhausen-type procedure. It is shown that in general the effects of curvature are more marked in adverse pressure gradients than in favorable ones. Author

N67-22966# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Plasmadynamik.
ON ONE-DIMENSIONAL FRICTIONLESS COMPRESSIBLE GAS FLOW WITH HEAT ADDITION AND AREA CHANGE UNDER PARTICULAR CONSIDERATION OF TRANSONIC REGIME [ZUR EINDIMENSIONALEN, REIBUNGSFREIEN, KOMPRESSIBLEN GASSTROEMUNG MIT AUFHEIZUNG UND QUERSCHNITTSAENDERUNG BEI BESONDERER BERUECKSICHTIGUNG DES SCHALLDURCHGANGS]
S. Krause Jan. 1967 82 p refs In GERMAN
(DLR-FB-67-02) CFSTI: HC$3.00/MF$0.65

The differential equation for the flow for ideal gases is numerically integrated. In this particular case of given area change and heat addition distribution, both may be reduced to one single parameter. Examples are given for the use of the diagrams. The results (especially in the neighborhood of Mach number 1) are compared with the behavior of gas flows with constant polytropic exponent. Author

N67-22972 Aix-Marseilles Univ. (France). Institut de Mecanique des Fluides.
EXPERIMENTAL STUDY AT M=7 OF THE EFFECTS DUE TO THE BLUNTING OF A CONE WITH WEAK APERTURE ON THE PARIETAL THERMAL FLUX AND ON THE FORM OF THE SHOCK WAVE [ETUDE EXPERIMENTALE A M=7 DES EFFETS DUS A L'EMOUSSEMENT D'UN CONE DE FAIBLE OUVERTURE SUR LE FLUX THERMIQUE PARIETAL ET SUR LA FORME DE L'ONDE DE CHOC]
J. Valensi, R. Guillaume, and D. Guffroy 31 Mar. 1966 105 p refs In FRENCH
CFSTI: $3.00

Pressure distribution and heat flux on the side wall of cones were considered, and experimental results were obtained as a function of abscissa of measuring points. Density distribution, shock wave form, test conditions, wind tunnel tests, type of model used, and scientific instrumentation were described. Extensive graphics are included. Transl. by R.U.

N67-22991# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.
AN OSCILLATORY DISTURBANCE OF RIGIDLY ROTATING FLUID
W. W. Wood Oct. 1965 54 p refs
(ARL/A-250) CFSTI: HC $3.00/MF $0.65

The effect of viscosity is examined for a particular configuration. The inviscid solutions are confirmed as true approximations to the flow at high Reynolds number for cases in which the internal inviscid velocity (but not velocity gradient) is continuous. The internal discontinuities become layers of thickness $O(R^{-1/3})$ in which the shears are $O(R^{1/6})$. The extreme sensitivity of the pattern of internal shear layers to the container's dimensions remains. Provided $R^{1/6} >> \log R$, the rough location of the strongest shears is insensitive to cell dimensions. A minute height change causes the original layers to split into a large number of parallel layers, with the strongest shears on layers near the original, and with a decay as $n^{-2/3}$ on the n'th singular surface numbered from the original. Author

N67-23054# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
DISTORTION OF A SHOCK WAVE TRAVERSED BY A VORTEX
L. T. Filotas Jan. 1967 30 p refs
(Grants AF-AFOSR-872-64; NRC A-2003)
(UTIAS-TN-96; AD-646759) CFSTI: HC $3.00/MF $0.65

A theoretical treatment of the sound field produced upon the interaction of a vortex and a normal shock wave was presented some time ago in UTIA Report No. 61 (H.S. Ribner, 1959). The techniques of this analysis are used to derive expressions for the shape of the distorted shock front. It is found that outside of the section cut off by the cylindrical acoustic wave emanating from the vortex center, the shock remains essentially straight. The portion within this section has curvature, resulting in a finite displacement of the two straight segments. These theoretical predictions are in qualitative agreement with the features noted by experimental investigators of the same phenomenon. As no other presently published theory yields the shock wave shape, this work demonstrates the generality of the approach used. Author (TAB)

N67-23121# Navy Underwater Sound Lab., New London, Conn.
A THEORETICAL ESTIMATE OF TURBULENT WALL PRESSURE FLUCTUATIONS ON A COMPLIANT BOUNDARY Research Report
Frank M. White and Robert E. Quaglieri Nov. 1966 41 p refs
(USL-767; AD-646133) CFSTI: HC $3.00/MF $0.65

A theoretical estimate is attempted for the effect of a compliant coating on turbulent boundary layer wall pressure fluctuations. The basic derivation shows that the problem reduces to one of finding the distribution in the wall plane of two correlations involving the wall pressure and its normal derivative. Exact expressions are derived for two-dimensional traveling wave pressure/velocity admittance of an isotropic elastic coating. These admittances are combined with some reasonable assumptions about the form of the pressure cross spectral density to yield approximate expressions for the two desired pressure/derivative correlations. Finally, two surface integrals of these correlations result in the wall pressure function in the presence of the compliant boundary. The calculations indicate that the compliant wall increases the mean square wall pressure at low speeds and decreases the pressure fluctuations at high speeds. Unfortunately, the reduction at high speeds probably cannot be achieved in practice because of the related mechanical problem of static divergence of the coating. Author (TAB)

N67-23155# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
TURBULENCE MEASUREMENTS RELEVANT TO JET NOISE
Wing T. Chu Nov. 1966 96 p refs
(Grants AF-AFOSR-672-66; NRC A-2003)
(UTIAS-119; AD-645322) CFSTI: HC $3.00/MF $0.65

Lighthill's equation for aerodynamic noise was reformulated in terms of its spectral characteristics using the one-dimensional fourier cosine transform. The final formalism is more revealing in that both the Doppler effect of moving eddies and the extent to which retarded time differences can be neglected are explicit in the final equation. Also the convection effect can be distinguished as a combined effect of Doppler shift and amplification. Experimentally, two-point space-time correlation of both the turbulent velocities and the square of these velocities were measured in the mixing region of a 4 inch model jet (about 142 fps) with constant temperature hot-wire anemometers. These measurements included the ordinary u-component and also the components at 45 deg. and 60 deg. to the jet axis. Results for the u-component agree well with those of previous investigators. Using the moving axis transformation of these space-time correlation functions together with the mean velocity measurements, an estimate of the basic directivity, the intensity, and the spectrum of both the shear and the self noise generated by a unit volume of jet turbulence was obtained. Author (TAB)

N67-23179# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
AN EXPERIMENTAL INVESTIGATION OF THE VELOCITY AND TEMPERATURE PROFILES IN THE BOUNDARY LAYER ABOVE AN UNSTABLE EVAPORATING FILM OF LIQUID UNDER THE INFLUENCE OF A MOVING STREAM OF HOT GAS
Donald L. Crabtree, Jr. and C. F. Warner Sep. 1966 229 p refs
(Contract Nonr-1100(21))
(JPC-429; TM-66-9; AD-645214) CFSTI: HC $3.00/MF $0.65

The thesis presents the results of measurements above an unstable evaporating film of water. Entrained liquid as droplets was present in the boundary layer. The measurements were made at one liquid flow rate at the following gas flow conditions: Total temperature - 980R, Total pressure - 250 psia, Gas velocity - 100 ft/sec, Axial static pressure gradient - less than 0.02 psi/ft. Photographs taken at 3 microsec were obtained of the interfacial structure of the liquid film. The temperature of the film was also measured. The experiments were conducted in a tunnel with a rectangular cross section 1 1/2 in. x 4 in. and 22 in. long, onto one side of which was injected the liquid as a film. Measurements in the boundary layer were carried out for both wet and dry walls. Author (TAB)

N67-23287*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATICALLY CONTROLLED AIR SPRING SUSPENSION SYSTEM FOR VIBRATION TESTING
Grayson V. Dixon and Jerome Pearson Washington, NASA, Apr. 1967 40 p refs
(NASA-TN-D-3891) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The suspension system consists of an air spring with a closed-loop position control of air spring height for supporting a test vehicle at various constant weights from 8000 lb to 100,000 lb or decreasing weights at rates up to 670 lb/sec when water is exhausted from the vehicle tanks to simulate propellent use. The system can maintain the air spring height and vehicle elevation by changing spring pressure and resultant spring stiffness with changes in vehicle weight. A vehicle-spring undamped natural frequency, which is low compared with the vehicle minimum elastic

mode frequency, is thereby automatically maintained over the entire weight range of the vehicle. By control of spring height, vibration exciters with displacement limits as small as ±0.25 in. are kept within their operating range when they are attached to a vehicle of varying weight. Response equations are developed for position command and force excitation of the suspension system and the system is also represented by equivalent spring-mass-damper configurations. The alternating components of the forces developed by the spring height control system, for sinusoidal excitation of the vehicle, are shown to be negligible for frequencies above the vehicle-spring undamped natural frequency. Some test results are included. Author

N67-23296*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STABILITY AND DRAG CHARACTERISTICS AT MACH NUMBERS OF 10 AND 28 OF A PROPOSED SLENDER ATMOSPHERIC PROBE

Gerald N. Malcolm Washington, NASA, Apr. 1967 37 p refs (NASA-TN-D-3917) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Free flight tests were conducted on models of a slender, flare-stabilized cone cylinder for use as a Mars-atmosphere probe. Results of nose-forward tests at Mach numbers of 10 and 28 and at Reynolds numbers of 0.6×10^6 showed extremely nonlinear but stable pitching moment characteristics. The stability at low angles of attack decreased rapidly with increasing angle of attack until the bow shock wave approached the windward side of the flare. Further increasing the angle of attack produced a notable increase in stability. No significant Mach number effects were observed in either the stability or drag results. Tests results at a Mach number of 10 showed the configuration was unstable in the nose-rearward attitude. The pitching moment for the model in this attitude was deduced from the rotational acceleration of the model. The pitching moment for the entire angle of attack range from $\alpha = 0°$ to $\alpha = 180°$ was determined by extrapolation of the experimental results. Models of the probe were found to be dynamically stable at all angles of attack tested. Author

N67-23299*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FREE JET IMPINGEMENT NORMAL TO A CURVED SURFACE IN A VACUUM

Leonard V. Clark Washington, NASA, Apr. 1967 74 p refs (NASA-TN-D-3920) CFSTI: HC$3.00/MF$0.65 CSCL 21H

An experimental investigation of highly underexpanded exhaust jets impinging normal to a curved surface was conducted in a 55-foot vacuum cylinder. The investigation included measurements of impingement pressures and of various bowshock characteristics. The curved surfaces were semicircular cylinders and impingement pressures were measured both along and around the cylinders which were located at various distances from the exhaust jets. Three nozzles were used with unheated nitrogen and helium; thus, six different sonic and hypersonic jets could be studied. The tests were conducted at pressure altitudes at or above 200,000 feet. The experimental data are compared with available theory to determine the applicability of analytical methods for predicting exhaust jet impingement pressures for a range of conditions. The results of this investigation verify previous experience and analysis and indicate that a simplified analysis is as good as the more cumbersome method of characteristics plus Newtonian analysis for determining impingement pressures resulting from underexpanded exhaust jets. Author

N67-23300*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PROGRAMS FOR COMPUTING EQUILIBRIUM THERMODYNAMIC PROPERTIES OF GASES

Harry E. Bailey Washington, NASA, Apr. 1967 23 p refs (NASA-TN-D-3921) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A series of subroutines, written in Fortran IV, is presented for calculating the equilibrium thermodynamic properties of any mixture of reacting diatomic gases if the temperature, density, and molar concentrations of the species are given. One triatomic gas, carbon dioxide, may also be included in the mixture. Two additional subroutines permit the calculation of the molar concentrations of the species if the gas mixture is air. A sample main program is included which uses all these subroutines to compute the equilibrium composition and thermodynamic properties of air for a given density over a range of temperatures. Author

N67-23411 Aeronutronic, Newport Beach, Calif.

EFFECT OF VEHICLE AND FLUID INJECTION GEOMETRIES ON NEAR-WAKE FLOW FIELD STRUCTURE

A. B. Bauer [1967] 36 p refs

The near-wake behind conical bodies has been studied experimentally for several configurations of nitrogen and helium injection through the cone base and for several different afterbody shapes added to the cone base. The afterbody shapes are found to reduce the strength of the wake shock, at least in the region two diameters behind the model, and to affect the viscous wake. The injection of nitrogen does not produce large changes in the strength of the wake shock, whereas helium decreases the shock strength. Both nitrogen and helium increase the width of the viscous wake. The injection was most effective with ports located near the edge of the cone base. Author

N67-23423# General Electric Co., Philadelphia, Pa. Missile and Space Div.

PURE AIR WAKE FLOW FIELD COMPUTATIONS

C. Sarkos 23 Nov. 1966 64 p refs (Rept.-66SD338)

A comparison of wake flow field computations is presented. The report is a summary of the computations made and discusses the aerothermochemical behavior throughout the flow field, particularly the effect of diffusion and chemical reactions. Author

N67-23428# McGill Univ., Montreal (Quebec). Space Research Inst.

SIMPLE INTERNAL BALLISTICS THEORY FOR SINGLE AND DOUBLE CHAMBER GUNS

G. V. Parkinson 26 Aug. 1966 24 p refs (SRI-H-TN-4) CFSTI: HC$3.00/MF$0.65

The equations of the well-known simple one-dimensional unsteady gas dynamics model for the internal ballistics of a conventional gun, assuming instantaneous uniform density throughout the propellant gas volume, are presented for use in HARP project. The principal equations give ratios of breech and space mean pressures to projectile base pressure in terms of charge to projectile weight ratio. The theory is extended to cover the problem of a double chamber gun system, with the chambers separated by a free piston. Again, results are given in the form of relations among the various significant gas pressure ratios in terms of charge to projectile and piston weight ratios. Author

N67-23445# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

IMPROVED TURBULENT SKIN-FRICTION COEFFICIENT PREDICTIONS UTILIZING THE SPALDING–CHI METHOD

J. J. Komar Nov. 1966 71 p refs (DAC-59801) CFSTI: HC$3.00/MF$0.65

A semiempirical method for the prediction of two-dimensional turbulent skin-friction coefficients is applied to computer programs related to the prediction of drag and aerodynamic heating.

Rapid calculation techniques and a design nomograph have been developed to facilitate engineering analyses. The difficulties inherent to the determination of the virtual origin of the turbulent boundary layer have been examined and a method developed which expresses a universal relationship between momentum thickness and running length from the virtual origin of the turbulent boundary layer for all values of Mach number and wall-temperature ratio where data exist. Author

N67-23461# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE ROLE OF INTERMITTENCY IN FREE TURBULENT FLOWS
K. T. Yen Jan. 1967 28 p refs
(R67SD3)

A theoretical analysis of the effects of intermittency on turbulent transport processes in free turbulent flows is presented. Turbulent fluctuations, in addition to those in the fully-turbulent fluid, are produced by the intermittency effects. It is shown that these additional fluctuations are significant for scalar quantities introduced in the turbulent fluid, but are insignificant for the velocity field based on Townsend's measurements. Dynamic equations governing the mean quantities and the fluctuations for both the velocity and temperature fields including the intermittency effects are derived. Based on these equations, the turbulent transport processes for momentum and heat are analyzed. It is found that (a) the turbulent Prandtl number is proportional to the intermittency factor, and (b) the mean velocity (defect) and temperature profiles are not the same, and the spread of the temperature profile is wider. A two-dimensional wake flow is worked out as a numerical example. The relevance of the present results to the hypersonic wake problem is discussed. Author

N67-23464# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ASYMPTOTIC UNIQUENESS FOR ELASTIC TUBE FLOWS SATISFYING A "WINDKESSEL CONDITION"
A. R. Elcrat and H. M. Lieberstein Feb. 1967 18 p refs
(Grant NIH HE-10034)
(R67SD9)

An improvement is presented of a theorem on mean square asymptotic uniqueness for viscous flow of an incompressible fluid in an elastic tube. Radial velocity components are ignored and no initial velocity profile is specified. Axial symmetry is dropped, however, and a "windkessel condition for uniqueness" is introduced to replace the former "normality relations." The windkessel condition is defined. It has heuristic relation to a condition that the capacity of the tube to absorb changes in square magnitude of the velocity does not increase as the flow proceeds down the tube, and it replaces any necessity to impose artificial boundary conditions at the ends of a tube section. The mean square difference between any two regular solutions decays exponentially with time. A relation between a bound for the decay rate and the radius is studied. The derivation of this decay rate utilizes a well known variational principle for eigenvalues. All conditions specified are intended to have a direct relevance to blood flow in the aorta. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-21982*# College of William and Mary, Williamsburg, Va.
OPTICAL RADAR MEASUREMENTS OF THE ATMOSPHERE
J. D. Lawrence, Jr., F. R. Crownfield, Jr., and M. P. McCormick Washington, NASA, Apr. 1967 54 p refs
CFSTI: HC $3.00/MF $0.65 CSCL 04A

Optical radar investigations of the atmosphere are discussed, including theoretical considerations that permit estimates of the optical radar returns from various altitudes. These preliminary data are used to discuss signal-to-noise ratios and to optimize various system parameters. Mie scattering intensity functions for backscatter are reviewed, and a computer printout gives the number of terms and the values for intensity functions for light backscattered per unit solid angle for alpha = .05(.01)2. 2(.1)50 and eta = 1.5. M.W.R.

N67-21999# Agrophysical Inst. (USSR).
THEORETICAL CONSIDERATIONS FOR THE USE OF HEAT FLOW METERS FOR HEAT FLOW MEASUREMENT IN SOIL, IN SNOW AND ICE COVERS
M. A. Kaganov and Yu. L. Rozenshtok *In* Israel Program for Sci. Transl. Ltd. Instr. and Methods for Meteorol. Observations 1966 110–115 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

An analytical solution is proposed for the problem of distortion of a stationary two-dimensional homogeneous temperature field by the presence of a body of limited size with thermal characteristics differing from those of the medium. A heat flow meter is regarded as a disk and is assumed to be an ellipsoid of revolution. In this case the problem is reduced to solving the Laplace equation for a temperature field of a flattened ellipsoid with its axes inserted in a medium with a uniform temperature field. The minor axis of the ellipsoid is normal to the isothermal surfaces. Data are also presented on the measuring errors found when using some of the available heat flow meters. M.G.J.

N67-22013# State Hydrological Inst. (USSR).
EXPERIENCE IN THE USE OF A GRADIENT-MEASURING SET-UP FOR DETERMINING EVAPORATION AND HEAT EXCHANGE IN FORESTS
S. F. Fedorov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 228–233 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Steel towers, carrying contact-type anemometers for wind speed measurements and thermistors for psychrometer-transducer recordings of temperature and humidity, were used to determine the evaporation rate and heat exchange in forests. Radiation balance and albedo of the forests were determined with wind-protected pyranometers and albedometers; soil temperatures were measured by thermometers; and rain gages on top of the towers obtained precipitation values. Results of two years' meteorological observations showed that wind speed varied little over the vertical within the forest, but above the tree canopy, a rapid increase in wind speed took place. Evaporation values calculated from heat-balance observations were higher than those obtained by water balance analysis for the months May and June; but during July and September, the second calculation method gave higher data. This discrepancy was attributed to insufficient accuracy in calculating the heat-balance components. G.G.

N67-22022# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE STUDY OF THE ATMOSPHERIC BOUNDARY LAYER FROM SHIPS
I. V. Vasil'chenko, P. A. Vorontsov, Yu. S. Dovgalyuk, and S. I. Maslov *In its* Instr. and Methods for Meteorol. Observations 1966 p 302–304 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Balloon-borne and helicopter-borne sounding instruments were used aboard two ships stationed in the Atlantic Ocean to

collect information on the atmospheric boundary layer. Helicopters were found to be feasible for air sounding, although a special takeoff and landing platform with a shipboard control center was required. Measurements of temperature, humidity, and pressure of the ocean surface layer were made on the 6000-ton ship to check the data obtained from the helicopter. Captive helium-inflated balloon soundings were made from a 1200-ton ship, and optimum launching conditions were at a cruising speed of 18 to 20 km/hr and a head-wind speed of not more than 4 to 5 m/sec. Rolling of the ship presented no particular difficulty, although launchings were not carried out during considerable pitching to avoid damping of the balloon cable. Balloon descent was at low speed and against the wind. M.W.R.

N67-22023# Limnological Inst. (USSR).
ACTINOMETRIC OBSERVATIONS FROM THE SURFACE OF LAKE BAIKAL
L. A. Borisova and M. M. Vykhristyuk *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 305–314 ref (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Equipment used and results obtained during actinometric observations made from a cutter and a boat on Lake Baikal are summarized. Special devices were used to eliminate the distorting influence of equipment and ropes on the magnitude of the incident radiation as measured by the cutter, as well as the water roughness and vessel vibration on the galvanometer readings made aboard the boat. Conditions necessary for the accurate measurement of total radiation are given. It is concluded that albedo measurements should not be made from shipboard because even the averaged values of distortion are too large, and that a boat-size vessel is preferable for such measurements. M.W.R.

N67-22024# Arctic and Antarctic Scientific Research Inst. (USSR).
CALCULATION OF RADIATION BALANCE FOR SEVERAL SITES IN THE ARCTIC REGION OVER A LONG PERIOD
L. F. Ovchinnikov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 315–323 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Based on observations made at several stations in the Arctic region since 1935, radiation balance of the underlying surface was determined by taking solarigraphic measurements of incident radiation and subtracting losses from albedo and back radiation. Although these actinometric measurements have been carried out for a long time, no uniform data have resulted. Data collected by a meteorological radiometer have been more useful. Since dependence of the radiation balance on the solar altitude is almost the same at various points in the Arctic region, it is concluded that radiation balance calculations can be made even when no actinometric data are available. Mean error is considered to be less than 10%. M.W.R.

N67-22033# Main Geophysical Observatory, Leningrad (USSR).
OPTIMUM METHODS FOR SNOW COVER OBSERVATIONS IN THE METEOROLOGICAL STATION NETWORK
M. V. Gushchina, R. L. Kagan, I. D. Kopanev, D. L. Laikhtman, and T. S. Trifonova *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 380–384 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The wide variety of snow cover conditions over the USSR does not permit the selection of a single optimum method for making surveys. Studies made in 1958 and 1959 indicate that daily observations from permanent snow stakes give a clear picture of the snow-cover depth variation over the winter, but do not reflect the nature of the snow pack on the area. In most instances, comparison of data from conventional field surveys with these snow-cover measurements show considerable discrepancies. Further, it is noted that increasing the number of measurements for the same snow survey does not result in a refinement of the mean data. Additional study of the problem is recommended. M.W.R.

N67-22034# Main Geophysical Observatory, Leningrad (USSR).
IMPROVEMENT OF SNOW-SURVEY METHODS
A. V. Dunaeva *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 385–394 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Analysis was made of results of a special snow survey of the catchment basin, an area of about 6 km^2, of the Buzinovka valley. Total length of the snow course was 33,550 m, and measurements were made at 10 m intervals. A random distribution of the snow cover is found, and there was no correlation of values measured at 10 m intervals. Mean values of snow depth along the measuring lines and three closed snow courses differ little from the general mean value for the whole area of the survey. The distribution of the snow cover is completely determined by the area topography and the underlying surface and does not depend on the shape of the snow survey route. M.W.R.

N67-22035# Academy of Sciences (USSR), Leningrad. Geographical Inst.
DETERMINATION OF THE AMOUNT OF SNOW TRANSPORTED BY WIND DURING SNOWSTORMS BY MEANS OF A RECORDING SNOW GAGE
N. I. Orlov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 395–400 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Although a vast amount of information has been collected on the snow-drift phenomena, quantitative data obtained has not been exact. Various attempts to improve data collection are mentioned, including (1) direct measurement of the density of wind-borne snow stream with the aid of radioactive cobalt and (2) a parallel light beam to record particles in the snow stream carried by wind. The radioactive method was not satisfactory, but the second method has produced some consistent results. Details of this method are given, and with two synchronously operating instruments stable results are obtained. Maximum concentration of particles in the snow-wind stream is noticed near the snow cover. With increase of height above the cover, the concentration decreases and particle speed increases. Changes in photocurrent and snow concentration are tabulated as a function of screening duration in the limiter of the recording system. M.W.R.

N67-22038# State Hydrological Inst. (USSR).
METHODS USED BY METEOROLOGICAL STATIONS FOR DETERMINING THE RATE OF SNOW MELTING
P. P. Kuzmin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 401–407 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Large-scale observations of snow melting are studied, with the total water content of the snow measured by snow stakes or from the attenuation of gamma rays passing through the snow cover. In order to develop accurate data on the rate of snow melting, site selection that is free of topographical anomalies is stressed. Data from so-called standard sites permit the extrapolation of data for large territories and for obtaining data for theoretical studies of heat and water conditions on the earth's surface. Local observations are necessary, of course, to study the influence of terrain and vegetation features. M.W.R.

N67-22038# Main Geophysical Observatory, Leningrad (USSR).
MEASUREMENT OF SURFACE TEMPERATURE BY THE RADIATION METHOD

V. L. Gaevskii *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 414–422 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

A radiation method described for measuring the temperature of a natural surface increases accuracy but is only applicable to low altitude measurements. Calculations are made on the basis of Planck's energy spectra distribution, data on NaCl filter transmittance, and averaged spectral absorption coefficients. With a water vapor content of 0.5 cm in the atmosphere, and a spectral range of 5.5 to 8 microns and above 13 microns, no appreciable amount of radiation reaches the radiation receiver from the earth's surface; only for the 8 to 12 micron band does this radiation pass without any significant changes. Water surface temperature measurements by this radiation method are shown for two different atmospheric stratifications. Checking the emissivity of the natural surface is considered in terms of increasing the accuracy of surface temperature measurements. M.W.R.

N67-22074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE DISTRIBUTION OF Ge IN THE METALLIC PHASES OF SOME IRON METEORITES

J. I. Goldstein Mar. 1967 27 p refs

(NASA-TM-X-55736; X-641-67-92) CFSTI: HC $3.00/MF $0.65 CSCL 08E

Germanium distributions in 10 iron meteorites with bulk Ge contents of 8.7 to 2000 ppm have been measured by electron probe microanalysis. Germanium is concentrated almost entirely in the metallic phases. It was redistributed in the temperature range at which the Widmanstatten pattern developed. The Ge content shows a positive correlation with Ni content, reaching a maximum in taenite and a minimum in kamacite at the kamacite–taenite interface. The distribution coefficient of Ge between kamacite and taenite is relatively content. The distribution of Ge is discussed in terms of its trace element behavior and its covariance with Ni. Author

N67-22078*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OGO-A MAGNETIC FIELD OBSERVATIONS

J. P. Heppner, M. Sugiura, T. L. Skillman, B. G. Ledley, and M. Campbell Mar. 1967 152 p refs

(NASA-TM-X-55740; X-612-67-150) CFSTI: HC $3.00/MF $0.65 CSCL 08N

The findings from the initial study of OGO-A fluxgate magnetometer measurements between 4 and 24.5 R_E are summarized. Data related to the following topics are presented and discussed: average and abnormal positions of the magnetopause and bow shock, the detailed cross-sectional structure of the bow shock, the generation of coherent waves and high frequency fluctuations at the bow shock, correlations between auroral zone negative bay onsets and sudden changes in the low latitude nighttime magnetosphere, the existence of unusually intense and stable magnetic fields at middle latitudes in the nighttime magnetosphere, the finding of persistent low latitude field behavior inside the magnetopause near the dawn meridian which implies a high β within this region and the existence of magnetopause instability, and the comparison of the high β field behavior near the dawn meridian with that near the dusk meridian. Details are also given on orbit and satellite orientation, the fluxgate magnetometer, and flight data characteristics. L.E.W.

N67-22144*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FLIGHT EXPERIMENT

John Flemming and J. J. Webb *In its* Radiometry Res. Mar. 1967 9 p (See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65

An experiment has been undertaken to measure the solar radiant flux and solar spectral irradiance from a NASA research aircraft in an effort to improve on the data presently available, most of which have been obtained from ground-based measurements. The instruments are presently being set up in the laboratory for intensity and wavelength calibration. Supporting equipment has been selected and ordered. Calibration techniques have been devised using quartz-iodine and mercury lamps. An elliptical flight path has tentatively been chosen. A study of possible sources of error has been made, and correction factors for mirror reflections, window transmissions, and other uncertainties have been considered. An 8% RMS error in spectral irradiance has been estimated. Modifications to the equipment to adapt it to the aircraft environment have been detailed. Author

N67-22212* Adelaide Univ. (Australia). Dept. of Physics.

MASS DISTRIBUTION OF SHOWER METEORS Progress Report, May 1–Oct. 31, 1966

W. G. Elford and B. J. Stone 31 Oct. 1966 32 p refs

(Grant NGR-52-042-003)

(NASA-CR-83328; PR-1) CFSTI: $3.00 CSCL 04A

A procedure for determining the mass distribution of shower meteors is applied to the results of precise meteor echo rates measured at two observatories. The determination of theoretical echo rate and time plots for various mass distributions and for a range of declination values of a point radiant is described, and the effect of change in the mass distribution law on the rate plots is discussed. Also explained is the method for removing sporadic background data in order to determine the shower echo rate from the total echo rate. A.G.O.

N67-22289* Washington Univ., Seattle. Dept. of Atmospheric Sciences.

ON THE USE OF INTERMEDIATE INFRARED AND MICROWAVE INFRARED IN WEATHER SATELLITES Annual Report

Konrad J. K. Buettner, Robert Dana, Kristina Katsaros, and William Kreiss Oct. 1966 60 p refs

(Grant NsG-632)

(NASA-CR-83518; AR-2) CFSTI: $3.00 CSCL 04A

A survey was made of the effects of the state of the sea on radiative measurements over water, and reflections at Nimbus I HRIR wavelengths are reported from the Antarctic continent and the altrostratus shield. An infrared emissivity experiment is discussed; as are observations with a microwave radiometer and the application of the Rayleigh–Jeans approximation. These studies are being made to determine the importance and utility of intermediate infrared and microwave infrared satellite measurements of surface emission and reflection. M.W.R.

N67-22286*# Volt Technical Corp., Washington, D. C.

EXPERIMENTAL INVESTIGATION OF THE EQUATORIAL IONOSPHERIC ANOMALY IN AFRICA IN THE PERIOD OF SOLAR MINIMUM [ETUDE EXPERIMENTALE DE L'ANOMALIE IONOSPHERIQUE EQUATORIALE EN AFRIQUE EN PERIODE DE MINIMUM SOLAIRE]

Paul Vila 15 Mar. 1967 12 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 22, no. 3, 1966 p 398–404

(Contract NAS5-12487)

(NASA-CR-83560; ST-AI-10577) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The equatorial ionization anomaly in the F-region has been explored with the help of airborne soundings during March–April and June–July 1965, periods of solar activity minimum. These two periods correspond at longitude observed to opposed symmetrical effects of solar radiation. A three-dimensional representation of the isolines f_0F_2 in latitude, local time, and altitude makes apparent several characteristic regions: at the center an equatorial plateau of high altitudes and low ionization directed along a narrow

ionization trough and propagating from South toward North; on the northern and southern edges of this plateau two crests of enhanced ionization developing unequally in the course of the morning and widening unevenly across subtropical zones. The warm crest, situated under the ecliptic, evolves slowly and attains a rather weak ionization maximum at about 1700 hours. The cold crest, which is the least exposed to solar radiation, becomes suddenly apparent at about noontime forming a narrower and much denser tropical ionization maximum. Current theories are unable to provide a satisfactory explanation of this phenomenon. Photoelectron and atmospheric heating are suggested as mechanisms, likely to differentiate the magnetic tubes of force affected by the equatorial F-region anomaly. Author

N67-22299*# Volt Technical Corp., Washington, D. C.
PERTURBATIONS OF AES ORBITS FROM TESSERAL HARMONICS OF GRAVITATIONAL POTENTIAL EXPANSION [VOZMUSHCHENIYA ORBIT ISZ OT TESSERAL'NYKH GARMONIK RAZLOZHENIYA GRAVITATSIONNOGO POTENTSIALA]
A. M. Zhandarov 8 Mar. 1967. 8 p Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 1, 1967 p 3–7
(Contract NAS5-12487)
(NASA-CR-83564; ST-CM-10571) CFSTI: HC $3.00/MF $0.65
CSCL 08N

A method is given for the determination of artificial earth satellite orbit perturbations from tesseral harmonics of Earth's gravitational potential expansion, and the intermediate orbit is utilized. Author

N67-22308# Isotopes, Inc., Westwood, N. J.
FLIGHT DATA AND RESULTS OF RADIOCHEMICAL ANALYSES OF FILTER SAMPLES COLLECTED DURING 1965 UNDER PROJECT STARDUST
Herbert W. Feely, David Katzman, Pierre E. Biscaye, John B. Panaccione, and Eugene R. French 1 May 1966 89 p
(Contract DA-49-146-XZ-079)
(HASL-176; PR-13) CFSTI: HC $3.00/MF $0.65

Flight data and results of radiochemical analyses of stratospheric and tropospheric air filter samples collected between January and December 1965 during Project Stardust are presented. Samples were analyzed for ^{90}Sr, ^{144}Ce, ^{137}Cs, ^{239}Pu, ^{238}Pu, ^{54}Mn, ^{109}Cd, ^{210}Po, and several products of cosmic ray activity including ^{7}Be and ^{32}P. Most of the sampler types used were calibrated by means of wind tunnel and/or in-flight studies. NSA

N67-22322# New York Univ., N. Y. Magneto-Fluid Dynamics Div.
COASTAL REFRACTION OF VLF WAVES
D. R. Dobrott 15 Apr. 1966 42 p refs
(Contract AT(30-1)-1480)
(NYO-1480-55; MF-51) CFSTI: HC $3.00/MF $0.65

The fundamental solution for VLF waves propagating past a shoreline in the earth–ionosphere duct is obtained in terms of an infinite series using the Wiener–Hopf methods. The effects of the land, sea and ionosphere are given in terms of complex impedance boundary conditions. As a result, each mode in the series is progressively damped. At low frequencies and distances far from the shoreline where a single mode dominates, reflection and transmission coefficients are obtained. When the ionospheric impedance is small and when the source and receiver are sufficiently elevated, the effect of the shoreline is not observable. However, when either the source or receiver is near the earth the portion of the wave reflected is proportional to the difference of sea and land impedances. At slightly higher frequencies, there exists an annular region about the shoreline where two modes propagate over the sea while, due to heavy damping, only one mode propagates over the land. The resulting increase of the field strength as the receiver passes from land seaward is the "recovery effec Author (NSA)

N67-22341# Israel Program for Scientific Translations, Ltd., Jerusalem.
ANTARCTICA COMMISSION REPORTS 1963
V. A. Bugaev, ed. 1966 206 p refs Transl. into ENGLISH of the book "Antarktika Doklady Komissii 1963" Moscow, Izd. Nauka, 1964 Published for NSF
(TT-65-50143) CFSTI: HC $3.00/MF $0.65

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13. PROPHYLACTICS OF DISADAPTATION PHENOMENA CAUSED BY WINTERING IN ANTARCTICA I. V. Shastin p 177–181 refs (See N67-22354 11-13)

14. DIFFERENT INTERPRETATIONS OF CERTAIN EXCERPTS FROM DOCUMENTS ON THE BELLINGSHAUSEN–LAZAREV EXPEDITION V. L. Lebedev p 182–187 refs (See N67-22355 11-13)

N67-22342# Israel Program for Scientific Translations, Ltd., Jerusalem.
MORPHOMETRIC PARAMETERS OF ANTARCTICA
I. A. Suetova *In its* Antarctica Comm. Rep. 1963 1966 p 1–5 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

Based on the more accurate data obtained during the IGY on the subglacial bed of Antarctica and on the thickness of continental ice, recalculations were made on the volume of ice and the mean elevation of bedrock. These pertain to the relief of bedrock, i.e., the surface of the rock Antarctica which can be subdivided into two principal regions—East Antarctica with adjacent islands situated above sea level, and West Antarctica, a small area sunken below sea level. The method used to plot the hypsographic curve is described; a figure depicting the hypsographic curves for ice and rock Antarctica is included. This shows that the

volume of ice in Antarctica (excluding ice shelves) is 23,377,000 km^3; with ice shelves, it is 23,920,000 km^3. The areas of hypsometric stages for the entire East Antarctica is calculated at 7,634,000 km^2. Tabulated data on the areas, volumes, and mean elevations of the continents are also presented. These indicate that the rock Antarctica lying above sea level is second to Asia with respect to mean elevation. M.G.J.

N67-22343# Israel Program for Scientific Translations, Ltd., Jerusalem.

GEOLOGICAL STRUCTURE OF ANTARCTIC PLATFORM

L. V. Klimov, M. G. Ravich, and D. S. Solov'ev *In its* Antarctica Comm. Rep. 1963 1966 p 6–19 refs Presented at the 1st Intern. Symp. on Antarctic Geol. (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

An historical account of the geological development of the Antarctic platform is presented, and the principal features of its geological structure are delineated. Due to the heterogeneity of its foundation, the platform regions are subdivided into two groups: the pre-Riphean and the post-Lower Paleozoic (Epicaledonian). Data are presented on (1) the pre-Riphean crystalline foundation, composed of a migmatized and granitized gneiss complex with abundant charnockite massifs; (2) the mantle of the pre-Riphena platform region; (3) the post-Lower Paleozoic platform region; (4) the folded foundation of the post-Lower Paleozoic platform region; and (5) the mantle of the post-Lower Paleozoic platform region. The most remarkable feature of the geological structure of the Antarctic platform is considered to be its pronounced resemblance to Brazil, Australia, Equatorial and South Africa (with Madagascar), and finally India. M.G.J.

N67-22344# Israel Program for Scientific Translations, Ltd., Jerusalem.

TECTONICS AND NEOTECTONICS OF ANTARCTICA

P. S. Voronov *In its* Antarctica Comm. Rep. 1963 1966 p 20–35 refs Presented at the 1st Intern. Symp. on Antarctic Geol. (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

An overview is presented on the progress made by geologists in solving such problems as (1) a more accurate delineation of the boundaries of the East Antarctic platform and the fringing folding zones; (2) more accurate knowledge of the internal structure of post pre-Cambrian (especially Alpine) folded zones and the establishment of the nature of the Ross–Weddell Depression; (3) the part played by regional faults (lineaments) in the structure of Antarctica; (4) the manifestations of neotectonics and isostasy in the morphostructure of the continent; and (5) the causes of the aseismic nature of Antarctica. The East Antarctic platform is defined as the region of ancient folded consolidation of the lithosphere which has been fringed by younger folded zones beginning with early Paleozoic. The significant modifications made in existing concepts on the boundaries of the platform are discussed in detail. These pertain to a tectonic scheme for the Antarctic continent; regional faults; tectonic movements; and the aseismic nature of the continent. M.G.J.

N67-22345# Israel Program for Scientific Translations, Ltd., Jerusalem.

ABSOLUTE AGE OF ROCKS IN EAST ANTARCTICA

M. G. Ravich and A. Ya. Krylov *In its* Antarctica Comm. Rep. 1963 1966 p 36–47 refs Presented at the 1st Intern. Symp. on Antarctic Geol. (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

To evaluate the absolute age of rocks, tabulated data are presented on 139 datings made by the argon method directly from samples, as well as determinations made from micas. Combined with the results of petrographic studies, this permits a comparison between ages of identical formations from different parts of East Antarctica. Rocks composing the crystalline foundation of the Antarctica platform—magmatized schists and plagiogneisses of granulitic facies, charnockits, and cross cutting granite–pegmatite veins—are divided into four groups with respect to their absolute age. It is concluded: (1) Rock formations in the middle structural stage of the Antarctic platform coincide with the time of the last and largest rejuvenation of individual large blocks of the crystalline foundation, the bottom structural stage in the platform. (2) The repeatedly rejuvenated pre-Cambrian crystalline foundation of the Antarctica platform is overlain by slightly metamorphosed rocks of the lower Paleozoic constituting the lower half of the platform mantle, or forming an independent Caledonian folded belt. M.G.J.

N67-22346# Israel Program for Scientific Translations, Ltd., Jerusalem.

CHARNOCKITES OF EAST ANTARCTICA

L. V. Klimov, M. G. Ravich, and D. S. Solov'ev *In its* Antarctica Comm. Rep. 1963 1966 p 48–63 refs Presented at the 1st Intern. Symp. on Antarctic Geol. (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

Geologic and petrologic data are presented on the shadow charnockites formed by the metasomatic granitization of schists in situ; and on the rheomorphic charnockites formed during intrusive movements, partially fused during the ultrametamorphism of rocks of granulite formation including shadow charnockites. A comparison of the chemical composition of schists which were charnockitized to different degrees shows that the formation process is characterized by an influx of alkalies and silica, and the removal of calcium, magnesium, and iron. It is pointed out: (1) The entire charnockite series is distinguished by high contents of titanium and phosphorus which are respectively included in ilmenite and apatite. (2) The formation mechanism has a limited effect on the chemical composition, e.g., ferrohypersthenic granitoids formed by metasomatosis in situ and by intrusive movements display very similar compositions. (3) A specific condition of the occurrence of fayalite in Antarctic charnockites is the low activity of water which prevents the formation of high-iron biotite, characteristic of ordinary subalkali granitoids. M.G.J.

N67-22347# Israel Program for Scientific Translations, Ltd., Jerusalem.

TEMPERATURES INSIDE ANTARCTIC GLACIERS

I. A. Zotikov *In its* Antarctica Comm. Rep. 1963 1966 p 64–110 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

The complexities involved in the complete theoretical solution of the heat transfer problem in a glacier are reviewed, and a simplification is introduced whereby consideration is given to a flat one-dimensional glacier. The processes of heat transfer in such a glacier are analyzed, and comparatively simple calculation formulas are derived for temperature determinations under different conditions of ice movements. These include possible types of vertical velocity distribution, variations in horizontal velocities and the shape of flow lines corresponding to these cases, cooling due to ice movements, warming due to motion, longitudinal compression of ice in the glacier, and change in the coordinate origin. Mean ice temperature is calculated for two regimes: cooling of the glacier due to movement of ice from top downward, and warming due to the movement of ice upward. Temperature gradients, which govern the magnitudes of thermal fluxes, are also determined, and the effect of the internal sources and heat flows on the temperature field are investigated. M.G.J.

N67-22348# Israel Program for Scientific Translations, Ltd., Jerusalem.

HEAT EXCHANGE BETWEEN ANTARCTIC WATERS, ICEBERGS, AND GLACIERS

V. L. Lebedev *In its* Antarctica Comm. Rep. 1963 1966 p 111–127 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

A quantitative calculation of heat exchange is presented, and the conditions which permit the cooling of waters by continental ice without its melting are determined. Tabulated data are presented on the time variation of the thermal flux for the correction factor of unity; the variation in the thermal flux through one of the boundaries in relationship to the distance from the corner of the glacier; the total thermal flux from water into ice through the lateral surface of a glacier; and thermal flux from water to the lateral surface of a glacier in the case of free convection. A comparison of these data shows that the cooling without melting (but with a certain salinization) is possible only at the relatively fresh ice surfaces and at water temperatures approaching the freezing point. Equations are also derived to evaluate the heat exchange through the bottom surface of a glacier. Possible cases of salinization and desalinization are examined. It is concluded that Antarctic glaciers cool and desalinize the surrounding waters; however, appreciable salinization can exist only in isolated places due mainly to the freezing of water in crevasses. M.G.J.

N67-22349# Israel Program for Scientific Translations, Ltd., Jerusalem.

BIENNIAL CYCLE OF ATMOSPHERIC CIRCULATION OVER THE ANTARCTIC

L. A. Zhdanov *In its* Antarctica Comm. Rep. 1963 1966 p 128–133 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

The mean January monthly AT_{50} charts of the Antarctic region were analyzed for the 1958 to 1963 period. The form of circulation in the lower stratosphere at the beginning of the year was examined, and its effects on the general trend of circulation in the troposphere and on the climatic parameters were assessed. Tabulated data are included on the mean values of geopotential altitudes and of temperature at the 50 mb surface in January of each year. The mean annual temperatures and pressures measured at the Mirny observatory are also listed. A comparison of these mean temperatures led to the conclusion that the overall annual temperature conditions at Mirny are to a degree predetermined at the beginning of the year, depending on the forming curvature of the geometric field of isohypses of atmospheric circulation in the mean monthly AT_{50} charts. M.G.J.

N67-22350# Israel Program for Scientific Translations, Ltd., Jerusalem.

EVALUATION OF THE DIRECTION OF SASTRUGI ON THE MIRNY–KOMSOMOL'SKAYA–VOSTOK TRAVERSE BY AERIAL PHOTOGRAPHY

V. A. Bugaev and V. I. Shlyakhov *In its* Antarctica Comm. Rep. 1963 1966 p 134–143 ref (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

The direction of sastrugi over the flight routes are examined, and tabulated data are presented on the coordinates of points on both flights at which the sastrugi were photographed, and the approximate distances of the points from Mirny. Based on detailed studies of the arrangement of sastrugi, their direction, and shape, it was concluded: (1) Snow ridges and drifts formed by cyclonic activity are morphologically different from sastrugi and deposits produced by katabatic and anticyclonal winds. Therefore, regions of active cyclonic activity can be differentiated from regions where coastal cyclones seldom appear. (2) If sastrugi are photographed at short intervals of a day or two over extensive areas, the movement of individual cyclones over the continent can be traced. (3) Sastrugi permit the identification of regions of developed katabasis and their direction, and therefore the general relief features in certain Antarctic regions. Recommendations on photographic techniques and processing are included. M.G.J.

N67-22351# Israel Program for Scientific Translations, Ltd., Jerusalem.

GEOGRAPHICAL OBSERVATIONS IN THE SCHIRMACHER OASIS (EAST ANTARCTICA)

V. I. Bardin *In its* Antarctica Comm. Rep. 1963 1966 p 144–166 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

Based on route and aerial visual geological–geographical investigations, data are presented on the Schirmacher Oasis, which is situated at the foot of the continental ice sheet along its boundary with the adjacent ice shelves. In considering the formation of the Oasis relief, attention is given to the role of tectonics, the effect of sheet glaciation, and the periglacial processes. It was noted that the wide development of chemical weathering is reflected in diverse crusts, coatings, and varnishes on rock surfaces. Although biochemical processes are suppressed, the vegetation in the Oasis was found to be much richer than that in the mountainous region lying to the south of it. Results of the chemical analyses of surface waters are listed; predominating types of water salinities are the sulfate–sodium and carbonate–sodium continental types. Glacial surrounding and certain aspects of the paleogeography of the Oasis are also described in relation to the glacial cover south and north of the Oasis; and sea bays in front of the northern edge of the Oasis. M.G.J.

N67-22352# Israel Program for Scientific Translations, Ltd., Jerusalem.

PHYSIOGRAPHIC ZONING OF ANTARCTICA

A. I. Orlov *In its* Antarctica Comm. Rep. 1963 1966 p 167–172 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

The theory of the zonality of the geographical processes in the Antarctic and Antarctica is discussed in relation to the zoning scheme proposed. The Antarctic belt is subdivided into three zones, with the ice continent of Antarctica considered as the most southern. Data are presented to show that the vertical zonality should be traced both in East and West Antarctica in spite of their different elevations, as the subzones of the Antarctic ice zone is identical in both. The territory of the continent is subdivided into four subzones: the central subzone of the ice sheet of major and minor Antarctica; the glacier slope; the marginal zone of the ice sheet; and the zone of ice shelves. These subzones are again subdivided into landscape types which are zonal. The characteristics of each are delineated. The largest manifestation of azonal differentiation is defined as the differentiation of the earth's surface into dry land and oceans. The theory that vertical zonality is the manifestation of azonal factors related to the internal energy of the earth is also discussed. M.G.J.

N67-22353# Israel Program for Scientific Translations, Ltd., Jerusalem.

TASKS OF THE PHYSIOGRAPHIC DESCRIPTION OF THE ANTARCTIC

K. K. Markov *In its* Antarctica Comm. Rep. 1963 1966 p 173–176 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

Summaries are presented on the various investigations undertaken in Antarctica. These include cartography and geography; morphometry; geomorphology and neotectonics; paleography; and geographical zoning. Among the accomplishments cited are the data obtained to establish that (1) the formation of residual ferruginous–manganous and residual–accumulative calcite and gypsum weathering crusts on the stone surface of Antarctica is subjected to a powerful flux of solar radiation; and (2) a regularity exists in the geographical distribution of different weathering crusts. M.G.J.

N67-22354# Israel Program for Scientific Translations, Ltd., Jerusalem.

PROPHYLACTICS OF DISADAPTATION PHENOMENA CAUSED BY WINTERING IN ANTARCTICA

V. Shastin *In its* Antarctica Comm. Rep. 1963 1966 p 177–181 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

In studying polar workers, principal attention was directed toward functional disorders of the cardiovascular system as this shows a high vulnerability to disadaptation. Neurotic disorders were observed principally in the first three or four wintering months, with the onset marked by general lassitude, irritability, headaches, unpleasant feeling in the heart region, and myalgias. In later stages, pains in the heart region, dyspnea at moderate physical efforts, disturbances in vasomotor regulation, and bioelectric and contractile capacities of the myocardium were noted. Disadaptational disturbances usually disappear in the second half of wintering. However, the point is made that absolutely stable acclimatization of men in Antarctica is impossible because of the extraordinary severity of climate. Strict medical screening of participants in expeditions is considered essential, and the recommendation is made that medical examinations should include electrocardiography and tachography in addition to the routine tests. M.G.J.

N67-22355# Israel Program for Scientific Translations, Ltd., Jerusalem.

DIFFERENT INTERPRETATIONS OF CERTAIN EXCERPTS FROM DOCUMENTS OF BELLINGSHAUSEN–LAZAREV EXPEDITION

V. L. Lebedev *In its* Antarctica Comm. Rep. 1963 1966 p 182–187 refs (See N67-22341 11-13) CFSTI: HC $3.00/MF $0.65

Analytical data are presented on the controversies centering around two essential points in the documents on the first Russian Antarctic Expedition (1819 to 1821). These pertain to the dating of the expedition events, in which both the civil and naval calendar were used; and the accuracy of the coordinates which appeared in the 1831 publication. The chronology of events in accordance with the naval and civil calendars is traced. Great emphasis is placed on the need of a more careful and painstaking approach to the documents of the expedition. M.G.J.

N67-22357*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.

AN ANALYSIS OF HIGH IONOSPHERE POSITIVE ION RAM PROBES

B. A. Pontano 1 Mar. 1967 59 p refs

(Grants NsG-134-61; DA-ARO(D)-31-124-G659)

(NASA-CR-83322; SR-291) CFSTI: HC $3.00/MF $0.65 CSCL 04B

An analysis of ion collection by a rocket borne probe is presented. The analysis is performed for both the planar and spherical geometry probes taking into account the presence of the ion sheath which surrounds the probe. The error introduced into the operation of the probe by the presence of the ion sheath is determined. The analysis is applied to the high altitude ion probe which was flown on Javelin 8.29 on May 19, 1965 as part of the Mother–Daughter project. Less than 2% error was attributed to the presence of the sheath for probe operation to an altitude of 500 km. At 500 km the sheath size approaches the probe dimension, and the probe ceases to operate according to ram theory. From the analysis, design suggestions are made which theoretically enable an ion probe of this type to operate with less than 2% sheath error to an altitude of 1000 km. Author

N67-22436*# GCA Technology Div., GCA Corp., Bedford, Mass.

SODIUM VAPOR EXPERIMENT Quarterly Progress Report, 1 Jul.–30 Sep. 1966

John F. Bedinger Oct. 1966 20 p refs

(Contract NAS5-3970)

(NASA-CR-83394; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The dynamics of the upper atmosphere through analysis of the motion of sodium vapor trails ejected from sounding rockets was investigated. Data are taken photographically from several widely separated sites. Triangulation is used to determine winds from the rate of motion of trail, and densitometry measurements determine the growth rate and small-scale structure of the trail. The first series of rocket firings occurred during November 1964 from Wallops Island and simultaneously from a ship at selected distances from Wallops Island. The objective of the series was to investigate the variation of the vertical wind structure at two places separated by different distances. The results of the first series were seriously limited by vaporizer malfunction, but one set of trails separated by 180 km showed the winds to differ significantly above 120 km. Author

N67-22458# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EXPERIMENTAL INVESTIGATION OF THE TURBULENCE STRUCTURE IN THE LOWER ATMOSPHERE

C. E. Elderkin Dec. 1966 299 p refs

(Contract AT(45-1)-1830)

(BNWL-329) CFSTI: HC $3.00/MF $0.65

Measurements of turbulence in all three components of the wind were made at several heights, in neutral, unstable, and stable conditions, and in a variety of wind speeds. The data were analyzed on an analog computer for power spectral density distributions, cospectral density distributions and Reynolds' stresses. Similarity of the power spectral distributions was observed for each of the components with some notable deviations. The spectra for the vertical component measured at 12 meters and above, where buoyancy becomes effective, demonstrated definite convective energy peaks. These occurred in addition to the mechanical energy peaks which corresponded to the normalized spectral distributions to those for the tests close to the ground where mechanical energy dominated the structure. A shift to higher wave numbers was detected for stable cases in the spectra for all three components. The shift was most noticeable at 12 meters where greater stabilities were more possible than close to the ground. The spectral function for the inertial subrange, described by Kolmogoroff's relation, $S(\kappa) \propto \epsilon^{2/3} \kappa^{-5/3}$, was detected consistently in the longitudinal and vertical component spectra. Reasonable values resulted for the universal proportionality constant, a, estimated best by a = .51, and dependence on $\epsilon^{2/3}$ was demonstrated. The additional factor of 4/3 required between the longitudinal and vertical one-dimensional spectra was missing, however. Only two cases for the lateral wind component showed a minus five-thirds dependence. The additional requirement for the inertial subrange, that the cospectra become zero, was observed to hold only down to $nz/\bar{U}$ = 1.0 to 3.0 while the minus five-thirds law for the power spectra extended somewhat below this value. Author (NSA)

N67-22470# Hermanus Magnetic Observatory (South Africa).

SEABORNE MAGNETIC MEASUREMENTS CAPE TOWN—SANAE, DECEMBER 1965–JANUARY 1966

H. D. Poole and A. M. van Wijk Sep. 11 p *Its* Geophys. Ser. No. 1

(B-7) CFSTI: HC $3.00/MF $0.65

The results of magnetic measurements carried out on board an Antarctic research ship are presented in tabular form. The data summarized are the observed values, uncorrected for transient changes in the magnetic field. L.E.W.

N67-22530# Dartmouth Coll., Hanover, N. H.
AN INVESTIGATION OF MASS TRANSFER BY SUBLIMATION FROM A SNOW-SURFACE
Clement B. Edgar, Jr. Sep. 1966 61 p refs
(Grant DA-AMC-27-021-63-G1)
(CRREL-SR-90; AD-645275) CFSTI: HC $3.00/MF $0.65

The problem of mass transfer by sublimation from a snow surface subjected to radiation and forced convection is investigated. The effect of irradiation from a nonisothermal source on the mass transfer rate is studied. Forced convection of the flat plate and entrance region type is investigated. Entrance effects are seen to have a negligible influence on the mass transfer rate. The effect of the nonisothermal snow surface is shown to be negligible. A thermal network analysis is developed to predict the mass transfer rate due to the combined effects of radiation and forced convection. Experimental results for mass transfer from a snow surface in the entrance region of a rectangular duct show good agreement with the predicted mass transfer rate. Author (TAB)

N67-22531# Little (Arthur D.), Cambridge, Mass.
DEVELOPMENT OF THERMAL CONDUCTIVITY PROBES FOR SOILS AND INSULATIONS
Alfred E. Wechsler Oct. 1966 113 p refs
(Contract DA-27-021-AMC-25(X)
(CRREL-TR-182; AD-645337) CFSTI: HC $3.00/MF $0.65

Eighteen laboratory-type and 3 field-type probes were designed, constructed and tested. Stainless steel, copper and plastic probe sheaths with epoxy resin, ceramic, or Woods metal fillings were used with bifilar and single or multiple wire constantan heaters. Copper-constantan thermocouples and thermistors located both within the probe and on the probe sheath were used as temperature sensors. Probes from 0.020 in. to 1/4 in. in diam. and from 3 to 24 in. in length were used. The probes were laboratory tested in dry and moist silt, gravelly sand, beaded polystyrene, and Foam-glass insulations over the temperature range from -40 to +90F. Measurements were also made in snow, ice, insulation boards, dry and moist silt, and gravel. The results of the tests indicate that the design and construction of probes for measurements of thermal conductivity of soils and insulating materials can be based on theoretical considerations with reasonable assurance of good probe performance and that the probes are useful and valuable for laboratory and field measurements. TAB

N67-22548# New York Univ., N. Y.
GROUND MOTION DUE TO SURFACE SOURCES
Richard Weiss Jun. 1966 98 p refs
(Contract DA-22-079-ENG-429)
(Rept.-3-158; AD-645540) CFSTI: HC $3.00/MF $0.65

The prediction of the distant ground motions due to large surface sources was attempted by means of a small mechanical vibrator. The effect of the geometry and loading of the source on the far field ground motion was studied. Author (TAB)

N67-22648*# Massachusetts Inst. of Tech., Cambridge.
GEOPHYSICAL RESEARCH
F. Bitter, G. Fiocco, and S. J. Bless *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 63-68 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Geophysical research in high magnetic fields and in upper atmospheric physics is reviewed and future plans are summarized. Changes made in the approach to the problem of producing megagauss fields by capacitor discharge, from using a single-turn coil to employing a Z-pinch, are described, and preliminary experiments made with the capacitors are discussed. A study conducted to determine a possible relation between dust and rainfall is reported. Observations were made of the dust content of the atmosphere at Lexington, Massachusetts for two years. The relative dust amounts at heights of 12 km and 16 km were correlated with the daily amount of precipitation averaged among 103 stations in New England. It was concluded that no evident trend exists to indicate a correlation between the two physical quantities. L.E.W.

N67-22899# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC PREDICTIONS FOR MAY 1967
Dec. 1966 4 p
(RRC-3128) CFSTI: HC $3.00/MF $0.65

Predicted median values are given for the eastern zone for the ordinary ray critical frequencies and for the maximum usable frequencies (MUF) for 4000 km. A nomogram is included for transforming F_2-zero-MUF and F_2-4000-MUF to equivalent MUF's at intermediate transmission distances. This has a conversion scale for obtaining optimum traffic frequency. M.W.R.

N67-22942# National Physical Lab., New Delhi (India).
LONGITUDINAL EFFECTS IN THE EQUATORIAL ANOMALIES OF THE F REGION
B. C. Narasinga Rao 30 Sep. 1966 60 p refs
(RPU-S30; SR-30) CFSTI: HC $3.00/MF $0.65

Longitudinal effects in the geomagnetic anomaly and diurnal anomaly in foF2 and h'F in the equatorial zone are studied on a seasonal basis during sunspot maximum. The width and magnitude of the geomagnetic anomaly as well as the position of the equatorial minimum, identified as the F region equator, are different in the Asian, African, and American zones and vary with season. The seasonal behavior in the diurnal bite-out phenomenon in foF2 and the post-sunset rise of h'F is different in the Asian and American zones. It is further observed that at equatorial stations there is solsticial anomaly depending on magnetic latitude rather than a winter anomaly depending on geographic latitude. Current theories of the geomagnetic anomaly are briefly reviewed. The fountain theory, which involves the diffusion of ionization along the geomagnetic lines of force after initial lifting over the equator, is found to be capable of explaining most of the observed features. Author

N67-22949 Meteorological Office (Gt. Brit.)
SECULAR VARIATIONS OF THE ATMOSPHERIC CIRCULATION SINCE 1750
H. H. Lamb and A. I. Johnson London, HMSO, 1966 28 p refs *Its* Geophys. Mem.-110, v. 14, no. 5
(Met.-O-711e) HMSO: £1 7s 6d

Circulation patterns were reconstructed over as much of the world as data permitted for individual months for over 200 years. Since it was necessary to start with just one or two sample months, January and July were chosen, and charts are presented for each January and July since 1750. There are also 10-yr mean charts for each decade from the 1750's to the 1950's and 40-yr mean charts are included for selected periods. Details are given on sources of data, ancient units and their conversion, construction of the charts, limits of the chart analysis, and circulation indices. L.E.W.

N67-22967# National Physical Lab., New Delhi (India).
IONOSPHERIC PREDICTIONS FOR MARCH 1967
Oct. 1966 5 p
(RRC-B128) CFSTI: HC $3.00/MF $0.65

Graphs are presented of the predicted median values of the ordinary ray critical frequencies and of the maximum usable frequencies for 4000 km. A nomogram for transforming F_2-zero-MUF and F_2-4000-MUF to equivalent maximum usable frequencies at intermediate transmission distances is included. N.E.N.

N67-22968# National Physical Lab., New Delhi (India).
IONOSPHERIC PREDICTIONS FOR FEBRUARY 1967
Oct. 1966 5 p For Abstract see N67-22967
(RRC-B125) CFSTI: HC$3.00/MF$0.65

N67-22974# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA—IV Monthly Graphs, Jan.–Aug. 1966
J. F. Steljes Sep. 1966 68 p
(CRGP-1244; AECL-2663) CFSTI: HC$3.00/MF$0.65

Uncorrected and barometer-corrected results from the cosmic ray stations in Canada are given in tabular form for the period from May to August 1966. Normalized graphs are given for the period January 1966 to August 1966. Author

N67-23010# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
IONOSPHERIC DATA FOR SEPTEMBER 1966 FROM SALISBURY, SOUTH AUSTRALIA
Oct. 1966 24 p
(CPD-1966/9(S)) CFSTI: HC$3.00/MF$0.65

This series of bulletins contains tabulations of ionospheric data obtained at Salisbury, South Australia, located at 34.7°S and 138.6°E. The ionossonde has been operated routinely and tables show the hourly values of the customary ionospheric parameters obtained during September, 1966. Author

N67-23011# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
IONOSPHERIC DATA FOR APRIL 1966 FROM WOOMERA, SOUTH AUSTRALIA
Oct. 1966 24 p
(CPD-1966/4(W)) CFSTI: HC$3.00/MF$0.65

This bulletin is one of a monthly series containing tabulations of ionospheric data obtained from a station at Woomera, South Australia, located at 30.8°S and 136.3°E. Tables contain the hourly values of the customary ionospheric parameters for April, 1966. Author

N67-23023 Centre de Recherches et d'Essais de Chatou (France).
BED-MATERIAL TRANSPORT STUDY BY TRACERS. TECHNOLOGY OF SEDIMENT-TRANSPORTATION MEASUREMENTS BY USE OF RADIOACTIVE TRACERS [ETUDE DU CHARRIAGE D'UN ECOULEMENT PAR TRACEURS RADIOACTIFS]
M. Heuzel Brussels, EURATOM, Dec. 1966 39 p refs In FRENCH
(Contract EURATOM-019-62-12-IRAF)
(EUR-3130.f, Vol. III) CFSTI: $3.00

Iridium 192, gold 198, and tantalum 182 were used as radioactive tracers to study sediment transportation. The tracers were selected according to the nature of the sediment (sand, mud, or pebble). Emphasis was on a new tracer injecting apparatus intended for continuous injection into the mud load of a dredger. Extended to the study of suspended load, scintillometers were used as detection devices. A detection device was designed which permits picking up undisturbed samples of mud or sand from the bottom. Depending on the availability of material facilities and on the particular topography of testing site, other detectors may be employed. To decrease the cost of the method, the development of navigation radioelectric networks are mentioned. Transl. by R.Ll.

N67-23039 National Physical Lab., New Delhi (India). Radio Propagation Unit.
RADIO PROPAGATION UNIT Progress Report, 1964–1965
1965 153 p refs
CFSTI: $3.00

Progress and activities in the IQSY are reported for projects involved with observations by the radio propagation unit. These projects include ionospheric physics, aeronomy, radio astronomy, space research, interdisciplinary projects, and international activities. Included in these major areas are studies covering ionospheric sounding, data coordination, sunspot prediction, D-region physics, ion kinetics, satellite studies, and ion probes. C.T.C.

N67-23055# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SPREAD FOOTING FOUNDATIONS ON SNOW
Sherwood C. Reed Apr. 1966 46 p refs
(CRREL-TR-175; AD-637112) CFSTI: HC$3.00/MF$0.65

A series of nine spread footing tests was installed on snow at Camp Century, Greenland, in 1961 and continuously observed through the 1963 summer season. The influence of footing load, size and shape on settlement were investigated and the effects of the uncontrolled parameters temperature and snow density were recorded. Author (TAB)

N67-23064 Norwegian Defence Research Establishment, Kjeller, Research Dept.
CALCULATIONS OF WAVE INDUCED MOTIONS AND LOADS. ADDITIONAL NOTES ON THE LONG TERM DESCRIPTION OF THE STATE OF SEA Progress Report
N. Nordenstroem 29 Jun. 1966 29 p refs
(Rept.-66-12-S; PR-3) CFSTI: $3.00

Visually estimated wave heights and periods are described for different sea zones on the North Atlantic and North Pacific Oceans according to a method which describes the long term distributions of wave heights and periods by the Weibull distribution function. The functional relationship between visually and instrumentally estimated wave heights and periods is discussed. A regression analysis of instrumental and visual wave height and period is appended. R.N.A.

N67-23095# Ionosphären-Institut Breisach (West Germany).
IONOSPHERE DATA, ABSORPTION MEASUREMENTS: FREIBURG, URSI-CODE 131, JULY–DECEMBER 1966 [IONOSPHAEREN-DATEN, ABSORPTIONS-MESSUNGEN: FREIBURG URSI-CODE 131, JULI–DEZEMBER 1966]
Dec. 1966 17 p In GERMAN
CFSTI: HC$3.00/MF$0.65

Presented are ionospheric absorption loss data as obtained by echo amplitude soundings at Freiburg station, West Germany. The period July through December 1966 is covered. Transl. by K.W.

N67-23128# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SURVEY OF ARCTIC AND SUBARCTIC TEMPERATURE INVERSIONS
Michael A. Bilello Oct. 1966 57 p refs
(CRREL-TR-161; AD-645597) CFSTI: HC$3.00/MF$0.65

This study provides a statistical analysis of available data on Arctic and subarctic inversions, and includes data from locations in Canada, Greenland, and Alaska. The analysis considers inversions with respect to frequency, base height, thickness, base temperature, and temperature gradient. TAB

N67-23158# San Calixto Observatory, La Paz (Bolivia)
INSTALLATION OF THE PENAS ACOUSTIC ARRAY Final Report
[1962] 6 p ref
(Grant AF-AFOSR-1177-66)
(AD-645151) CFSTI: HC$3.00/MF$0.65

The article describes the installation and operation of an acoustic array of microbarographs able to register infrasonic pressure disturbances of the atmosphere. TAB

N67-23178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME RESULTS OF EXPERIMENTAL INVESTIGATION OF THE STRUCTURAL CHARACTERISTICS OF AIR FLOW IN THE SURFACE BOUNDARY LAYER OF THE ATMOSPHERE

N. M. Galadzhiy, A. R. Konstantinov, and V. V. Belousov 29 Jul. 1966 19 p refs Transl. into ENGLISH from Ukr. Nauchno-Issled. Meteorol. Inst. (Kiev), no. 41, 1964 p 87–94

(FTD-TT-65-2036; AD-645852) CFSTI: HC $3.00/MF $0.65

Results are presented of the investigation of some structural characteristics of turbulent air flows in the surface layer. An exposition is given of the dependences of the structural characteristics of turbulence and the coefficient of the turbulent exchange on the temperature stratification of the atmosphere and on the altitude above the underlying surface. Author (TAB)

N67-23207# Atomic Weapons Research Establishment, Aldermaston (England).

SPECIAL PURPOSE LEAST SQUARES PROGRAM

A. Douglas Nov. 1966 35 p refs

(AWRE-O-54/66) BIS: $1.00; HMSO: 5s

The relative size, M(I,J), of the seismic signal recorded at station I from the Jth explosion at a particular firing site is assumed to be given by the equation: $M(I,J) = B(J)+S(I)+\epsilon(I,J)$, where B(J) depends on the size of the explosion and S(I) is a station term dependent mainly on the distance of the Ith station from the firing site. M(I,J) is measured from seismic records and will usually be in error; and $\epsilon(I,J)$ is the error term. A least squares program is described for estimating: B(J) and S(I), the confidence limits on these quantities, and the differences, and confidence limits on the differences, between all possible pairs of B(J). Although written for a specific purpose, the method is general and can be used to estimate any quantities that can be expressed as equations of the above type. Author (NSA)

N67-23302*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

THE STRUCTURE OF AN ATMOSPHERE FROM ON-BOARD MEASUREMENTS OF PRESSURE, TEMPERATURE, AND ACCELERATION

Simon C. Sommer, Alfred G. Boissevain, Layton Yee, and Roger C. Hedland Washington, NASA, Apr. 1967 56 p refs

(NASA-TN-D-3933) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A method has been developed for determining the structure of a planetary atmosphere from measurements of pressure, temperature, and acceleration made on board an entry vehicle. Determination of the average molecular weight of the atmosphere is an important by-product of this type of measurement. Data obtained from drop tests of instrumented capsules into the earths atmosphere from high altitude have been analyzed. The atmosphere structure and the vehicle trajectory determined from these data are in excellent agreement with those obtained from ground-based observations and meteorological measurements. The deduced molecular weight was within 3 percent of the average value of air. Author

N67-23319*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SOLAR AND GEOMAGNETIC EFFECTS ON UPPER ATMOSPHERIC TEMPERATURE

S. Chandra and B. V. Krishnamurthy Mar. 1967 14 p refs Prepared for publication

(NASA-TM-X-55749; X-615-67-109) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The effect of solar extreme ultraviolet (EUV) and corpuscular radiation on upper atmospheric heating was studied, using the parameters of solar decimeter flux and the daily variations of the geomagnetic activity on the ground. The varying effects associated with 10.7 cm flux and K_p (magnetic index) on atmospheric temperature during the solar cycle indicate that during high sunspot activity changes in solar EUV radiation are large enough to mask a corpuscular radiation effect. However, during low sunspot activity, the EUV flux remains stationary so that corpuscular effects on temperature become noticeable. An examination of 10.7 cm flux and temperature data from Explorer IX shows that long term variations such as the 27 day variations in upper atmospheric temperature are correlated with those in 10.7 cm flux. Short term variations in temperature such as day to day variations are correlated with geomagnetic fluctuations as represented by $\Delta\Sigma K_p$ (the daily sum of geomagnetic indices representing the average magnetic activity of the day). R.N.A.

N67-23321*# National Aeronautics and Space Administration, Washington, D. C.

THE INTERNAL STRUCTURE AND PHYSICS OF THE EARTH

V. A. Magnitskiy Apr. 1967 455 p refs Transl. into ENGLISH of the book "Vnutrenneye Stroyeniye i Fizika Zemli" Moscow, Izd. Nedra, 1965

(NASA-TT-F-395) CFSTI: HC $3.00/MF $0.65 CSCL 08K

Presented are contemporary concepts regarding the internal structure of the Earth, shell formation processes, and future evolution. Attention is concentrated on crust formation and on mantle-crust interaction. Planetary thermics and structure and physical properties of the shell material are discussed on the basis of data from seismology, gravimetry, and observations of natural oscillations and tides within the Earth. Terrestrial rheology, the behavior of the mantle at high pressures and temperatures, and phase transitions at high pressure are treated. Analyzed are the hypotheses regarding the basic boundaries within the terrestrial sphere. Zone melting in the mantle is examined, and an attempt is made to provide a theoretical basis for explaining the vertical movements in the crust and to clarify crust evolution. K.W.

N67-23355# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

A PRELIMINARY REPORT ON ABSOLUTE SKY RADIANCE MEASUREMENTS IN THE REGION OF 1.5 TO 3.2 MICRONS

Freeman F. Hall, Jr. Jul. 1966 20 p refs

(Douglas Paper-4137; AD-644986) CFSTI: HC $3.00/MF $0.65

An investigation to measure the absolute radiance distribution of the night sky in the spectral region from 1.5 to 3.2 microns is described, together with the instrumentation designed for the study. A 61-cm aperture Newtonian radiometer with an f/2 cast aluminum mirror directed radiation to a 30-element PbS linear array. Individual solid state amplifiers were used for each detector, and total field chopping with electronic zero suppression provided detection for both point and diffuse sources. Each detector subtended a field of view of 1 x 1 minute of arc. Atmospheric and instrumental fluctuations usually limited minimum detectable radiance. Measurements of the Crab Nebula confirm radiance values previously published by Moroz. Results of scans across other known diffuse sources are also reported. Several bright infrared stars were found which do not correspond in position to known late stars. Author (TAB)

N67-23410# National Oceanographic Data Center, Washington, D. C.

EQUALANT III Data Report

Albert M. Bargeski and Murray Fogelman, comp. 1965 464 p (G-7) Available from Natl. Oceanog. Office, Washington, D. C.: $5.00

Tabulated results are presented of the Equalant III fishery and biology oriented oceanographic survey of the tropical Atlantic. Seven ships participated and made measurements of direct currents using anchored buoys, current meters, drogues, or any combination of these for those ships with the capability. Observations and samples common to most vessels at designated intervals were: hydrographic casts, BT's, surface meteorology, oxygen, and phosphates. Detailed studies were made of the equatorial undercurrent, and of the contents of shark's stomachs. C.T.C.

N67-23418# Israel Program for Scientific Translations, Ltd., Jerusalem.

LIGHT AND HEAT RADIATION IN STRATUS CLOUDS

E. M. Feigel'son 1966 251 p refs Transl. into ENGLISH of the book "Radiatsionnye Protsessy v Sloistoobraznykh Oblakakh" Moscow, Izd. Nauka, 1964 Publ. for Dept. of Commerce and NSF

(TT-66-51014) CFSTI: HC$3.00/MF$0.65

The propagation process of radiant energy in clouds, and the role of radiation in the formation and development of clouds are investigated. The problem is solved under the theory of radiation transfer in a highly scattering media which includes such geophysical objects as clouds, seas, and snow; and in some cases required development of special methods of solution. The study is conducted in two major parts: (1) investigation of the optical regime of clouds; angular and spectral distribution of emergent radiation, and (2) elucidation of the role of radiant energy in physical processes related with cloud evolution and atmospheric thermodynamics. C.T.C.

N67-23431 Joint Publications Research Service, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 149

31 Jan. 1967 73 p refs

(JPRS-39718; TT-61-11147-149)

Soviet research in the fields of astronomy, meteorology, oceanography, terrestrial geophysics, upper atmosphere, and space science are presented in abstract form. Among the subjects considered are: solar activity, lunar surface, radio emission, forecasting pressure fields and air temperature, air circulation, strontium content in oceans, faults, granite formations, mapping soils, geomagnetic fields, cloud formation, meteor dust, lunar satellites, and cosmic rays. S.P.

N67-23433 Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 369. IONOSPHERE AND IONOSPHERIC SURVEY

Kao Yu 2 Mar. 1967 23 p Transl. into ENGLISH from Wu-Li Tung-Pao (Peking), no. 3, Jun. 1963 p 121–128

(JPRS-40093; TT-67-30740)

An overall survey is presented on the ionosphere surrounding the earth. The behavior of electron density distribution is discussed to give the structural characteristics of the ionosphere; and effects of the ionosphere on the transmision of radio waves are cited. Equations are given for the propagation of radio waves; and the vertical pulse survey method for ionospheric survey is described. The normal changes and calculation of electric current in the ionosphere are discussed. Other areas considered are the horizontal motion of the ionosphere and inhomogeneity, abnormal changes, rockets and satellites for ionospheric study, and application of research. S.P.

N67-23434 Joint Publications Research Service, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 147

4 Jan. 1967 81 p refs

(JPRS-39400; TT-61-11147-147)

Abstracts and news of scientific research are presented in the fields of astronomy, meteorology, oceanography, terrestrial geophysics, upper atmosphere, and space research. Items such as the solar corona, flares, and atmospheric transparency are considered in astronomy discussions. Meteorology discussions include: measurement of air temperature, cloud processes, wind velocity, and the theory of atmospheric condensation nuclei. News in the field of an oceanography focused on deep sea research, hydrooptics, light propagation in water, and direction of surface currents. In the area of terrestrial geophysics seismology data is treated extensively. Upper atmosphere and space research data studies of artificial satellites, solar flares, magnetoionospheric disturbances, and radar echoes are among the subjects discussed. S.P.

N67-23435 Joint Publications Research Service, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 198

17 Jan. 1967 110 p refs

(JPRS-39571; TT-61-1147-148)

Continuing research in the areas of astronomy, meteorology, oceanography, terrestrial geophysics, upper atmosphere, and space science is presented in the form of abstracts and news items. Some of the topics included in the discussions are: dwarf stars, solar activity, cosmic rays, clear-sky turbulence, wind analysis, climatology, air temperature, ocean currents, water temperatures, magnetic anomalies, gravimetry, lunar spacecraft, satellite motion, and geomagnetic storms. S.P.

N67-23460# Joint Publications Research Service, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE

17 Feb. 1967 135 p refs

(JPRS-39945; TT-61-11147-150) CFSTI: HC$3.00/MF$0.65

An annotated bibliography is presented on research in the following areas: astronomy, meteorology, oceanography, terrestrial geophysics, upper atmosphere, and space science. Among the topics covered are: magnetic fields, lunar surface, clouds and precipitation, solar activity, weather forecasting, ocean currents, seismic waves, meteorites, and radio waves. S.P.

N67-23473 International Geophysical Year World Data Center A, Washington, D. C.

CATALOGUE OF DATA IN WORLD DATA CENTER A—AIRGLOW, IONOSPHERE, AURORA (INSTRUMENTAL), AURORA (VISUAL), COSMIC RAYS, GEOMAGNETISM, SOLAR ACTIVITY, 1 JULY 1957–31 DECEMBER 1966

Feb. 1967 153 p

Upper atmosphere geophysical data are listed. Covered are areas such as airglow, cosmic rays, ionosphere, geomagnetism and solar activity. C.L.W.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-21991# Leningrad Hydrometeorological Inst. (USSR).
AUTOMATIC INTEGRATING FLUCTUATION METERS AND GRADIENT RECORDERS
M. L. Gol'denberg, L. G. Kachurin, and B. Ya. Tolstobrov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 45–55 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The factors involved in selecting a computer for the automatic integrating fluctuation meter (AIFM) are defined, and a distinction is made between fluctuation meters with a fixed averaging range (FRAFM) and fluctuation meters with continuous averaging (CAAFM). Both types have signal integrators which basically differ. A block diagram is shown of a design for a FRAFM unit used for determining structural characteristics. The signal from the sensor is fed simultaneously to the integrating and memory units. After a certain time lapse equal to the averaging interval, two signals are fed to the subtraction unit: one from the memory unit with a time delay, and one from the integrating unit with the signal constant and equal to the average value. This signal is measured simultaneously by the voltmeter with a high input resistance. The CAAFM systems differ only by the type of integrator used and by the absence of the memory unit. Wiring diagrams are shown of the computing unit for a version of the FRAFM system, used to determine the structural properties of airflow direction in the vertical and horizontal planes. The main characteristics of automatic gradient recorders are described. M.G.J.

N67-21992# Agrophysical Inst. (USSR).
A MICROCLIMATIC STATION FOR MEASUREMENTS IN HERBAGE
I. G. Mushkin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 56–65 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

In the instrumentation design for the microclimate station, thermistors are used as transducers. The microclimate station is intended for measurements of temperature, humidity, and velocity of the air included in the herbage, and contains two basic units: a semiconductor hot-wire anemometer, and a nonventilated psychrometer. The air flow velocity is measured by a semiconductor hot-wire anemometer with automatic temperature compensation. The device is based on the relationship between the heat release from a body and the flow velocity of the medium. A hot-wire anemometer equipped with a special amplifier was developed to correct the device's sensitivity to increases in wind velocity. Air humidity and temperature are measured with an electronic psychrometer equipped with thermistor sensors. The psychrometric coefficient of the device was calculated in order to select the optimum design of the wet bulb thermometer. M.G.J.

N67-21993#
NEW DEVELOPEMENTS IN AUTOMATIC METEOROLOGICAL INSTRUMENTATION
Fl. Patrichi *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 66–69 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Details are given on an automatic meteorological station located on a Rumanian mountain. The station operates according to a predetermined program; every three hours it measures and transmits air temperature, humidity, pressure, and wind direction and velocity. Before each transmission cycle, the radio transmitter sends a signal for tuning the receiver at the receiving center. Duration of the control signal is two minutes; duration of the working cycle is from four to six minutes, depending on the rotational speed of the miniature electric motor that actuates the measuring and coding devices. The radio transmitter consists of one vacuum tube, consumes 0.5 W, and operates on the ultrashort wave band. The automatic station uses the following types of transducers. Air temperature is measured by a liquid thermometer with glycerin (passive fluid) and toluol (the working fluid). Air pressure is sensed by a standard frictionless pressure gauge. Air humidity is determined with a human hair hygrometer. The instrument has 10 contacts for 10 values of air humidity. Wind direction is measured with an eight-point contact system transmitting eight directions. M.G.J.

N67-21995# Main Geophysical Observatory, Leningrad (USSR).
MINIATURE DEVICES FOR MEASURING HEAT RADIATION
V. S. Aleksandrov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 80–86 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Compact, small size units were developed for use with thermoelements and bolometers under field conditions. A dc amplifier was devised for work with thermocouples. The dc voltage from the thermoelement is applied to a contact converter, where it is transformed into ac voltage of 600 cps frequency. After amplification in the ac amplifier, it is transformed into dc voltage in the synchronous detector, and fed to the recorder or indicator. Stability is increased by providing an overall dc negative feedback, which makes the amplifier independent of the surrounding temperature and supply voltage. For the bolometer, an ac amplifier with an input radiant heat modulator was developed. The operating principle of the unit is described, and a circuit diagram is presented. M.G.J.

N67-22002# Central Aerological Observatory (USSR).
INSTRUMENTATION FOR METEOROLOGICAL OBSERVATIONS FROM HELICOPTERS
V. P. Belyaev, N. K. Vinnichenko, and L. A. Pakhomov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 126–133 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

An electrometeorograph, designed for helicopter meteorological observations, was developed to accurately measure temperature fluctuations, humidity, air pressure, and g-load variations that reflect atmospheric turbulence. An automatic optical recorder converts these parameters into electrical signals which are recorded on a light-sensitive strip chart. The system consists of a profiled stand with protection shields for the temperature, temperature fluctuation, and humidity sensors; potentiometric pressure sensor and g-load sensor; power pack measuring bridge unit; optic recorder; remote control board of the recorder; electric clock; and calibration unit. Each component, and its operation, are described. Flight tests led to the conclusion that the device has excellent performance characteristics. M.G.J.

N67-22008# Main Geophysical Observatory, Leningrad (USSR).
PRESENT-DAY STATE OF AND TRENDS IN THE DEVELOPMENT OF WIND-PARAMETER MEASUREMENTS
N. G. Protopopov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 172–187 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Sufficient accurate characterizations of wind measurements were obtained by a new instrument that consists of an anemometer connected to an automatic console, and an anemograph with a storage register. Both devices have the same speed and direction transducers that convert measured wind parameters into electrical signals for automatic processing and digital printout. Recorded were instantaneous and time-averaging wind speed and direction, as well as the angle of wind direction. Two attached wind vanes functioned as dampers by deviating wind gusts that did not coincide in direction, amplitude, and time of action. The described instrumentation obtained the mean wind vector by synchronous averaging of wind parameters for a given time interval. G.G.

N67-22009# Scientific Research Inst. of Hydrometeorological Instruments (USSR).
RESEARCH ON WIND-PARAMETER TRANSDUCERS

A. A. Syiko, D. Y. Surazhskii, and V. U. Torochkov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 188–201 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Field investigations of anemometers showed that their wind speed transducers have a correlation coefficient with an anemograph close to unity. Wind tunnel investigations of cup-type and screw-type anemometers established only a small difference in their wind direction measurements; for a given anemometer geometry the synchronization path varied only with wind speed. G.G.

N67-22010# Main Geophysical Observatory, Leningrad (USSR).
EXPERIENCE IN THE USE OF NEW TYPES OF WIND-MEASURING INSTRUMENTS

V. E. Karpusha *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 202–206 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The advantages of wind recording instruments over wind indicating devices were evaluated, and a battery powered apparatus was developed that recorded both wind direction and speed. Analysis of various causes of faulty operation showed that instrument assembly and adjustment were sometimes not satisfactorily performed. Reliable operation of new electromechanical measuring devices should include the following considerations: (1) preliminary control before installation at weather station; (2) new instruments should be installed under professional supervision and after successful testing; (3) creation of an emergency stock with a centralized maintenance shop; and (4) creation of a special training shop to acquaint personnel with new instruments before installation. G.G.

N67-22012# Ukrainian Scientific Hydrometeorological Inst. (USSR).
EVALUATION OF MEASURING ERRORS OF ASPIRATION AND STATION PSYCHROMETERS USED FOR THE MEASUREMENT OF AIR TEMPERATURE AND HUMIDITY IN ATMOSPHERE WITH NONUNIFORM TEMPERATURE FIELD

A. R. Konstantinov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 217–227 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The inaccuracy in measurements of air-temperature and humidity gradients was attributed to the time lag of the measuring devices and the periods of anisotropic turbulent fluctuations of air temperature with its nonuniform distribution. Analyses of recorded anemograms established a close relationship between fluctuations of vertical wind speed and air temperature, an increase in fluctuation magnitude with instability of stratification, and a pronounced anisotropy of fluctuations of vertical wind speed and temperature. Measuring coefficients for the station type psychrometers was made more efficient by covering the mercury well of their thermometers with insulating material. G.G.

N67-22014# Scientific Research Inst. of Hydrometeorological Instruments (USSR).
THE USE OF ELASTIC LINKS IN HYDROMETEOROLOGICAL INSTRUMENTS

K. N. Manuilov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 234–239 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Developed and tested were new elastic link designs for hydrometeorological instruments to improve their accuracy and reliability. The following results were obtained: (1) replacement of a conventional end support in an anemometer by a string shaft increased its sensitivity, reliability, and service life, and made the instrument resistant to shock and vibrations up to 5 or 6 g; (2) a combination wire-type support with elastic links in the pressure unit of a radiosonde created a sensitive transducers with random errors below hundredths of one percent; (3) double-twist cylindrical springs as mechanical elements for measuring linear quantities created a sturdy device with a measuring error of 0.2%; and (4) a double-bimetal spring used as temperature sensing element in a radiosonde reduced the lag coefficient of the instrument by a factor of 5. G.G.

N67-22015# Agrophysical Inst. (USSR).
THE USE OF THERMISTORS IN AIR-HUMIDITY MEASUREMENTS

M. A. Kaganov *In* Israel Program for Sci. Transl. Ltd. Instr. and Methods for Meteorol. Observations 1966 p 240–252 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Small-sized thermistor sensors for psychrometers increased their temperature measurement accuracy by generating electrical signals that were used in electrical analog circuits for the automatic solution of the psychrometric equation relating humidity to the transducer outputs. On the strength of this principle, a measuring device for the direct determination of air humidity was developed and its circuit diagram and cross section construction are shown. Termistors can also improve dew point hygrometers by direct measurements of relative humidity with a balanced bridge that determines the ratio between the resistance of two thermistors which measure both the temperature of the mirror and the air temperature. G.G.

N67-22016#
SOME EXPERIMENTAL DATA ON THE BEHAVIOR OF TEMPERATURE SENSORS IN AN ANISOTROPIC TURBULENT AIR STREAM

L. R. Struzer and V. V. Lozovskii *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 253–258 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Measurements of temperature gradients in the atmospheric ground layer were collected during the years 1959 through 1960 by simultaneous use of aspiration psychrometers and thermoelectric gradient meters. Comparison of obtained results showed that: (1) both instruments yielded the same temperature and humidity values during night; (2) daytime temperature measurements by gradient meters were about 0.10 to 0.15°C higher than values obtained with psychrometers; (3) both instruments yielded almost the same results in the range of positive values of air-humidity gradients ($\Delta e > 0.5$ mb); and (4) for humidity gradients higher than 0.5 mb, the gradient meters obtained regularly higher values than the psychrometers. It was concluded that gradient measurements depended on the transmission lag of the sensing instruments; the magnitude of distortion, in turn, depended upon the temperature stratification of the atmosphere and on measurement levels. G.G.

N67-22017# Main Meteorological Observatory, Minsk (USSR).
RESULTS OF TESTS ON THE PERFORMANCE OF POLARIZATION VISIBILITY METERS FROM MEASUREMENTS CARRIED OUT DURING THE DAY

I. A. Savikovskii *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 259–265 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Basic performance characteristics and error range were determined for a polarization visibility meter that measures the visual contrast between a remote object and the sky background by photometric comparison, or by comparing the relative brightness. From error data in measuring the visible contrast, on the fluctuations of true contrast between the object and sky background, and the error due to polarization, the root-mean square error was calculated for visual range measurements by both techniques. It was found that variation of the relative error ratio between distance and object increased with distance and that therefore the error increased

until observations were carried out with the next, more distant object. Accuracy increased greatly upon positioning of a black screen at about 200 to 300 meter distance from the object. The relative-brightness method was very sensitive to fluctuations in the true contrast between the object and internal haze; it was concluded that the photometric comparison method is suitable for small visual ranges, and the relative brightness method for larger distances.
G.G.

N67-22019# Central Aerological Observatory (USSR).
AIRBORNE INSTRUMENT FOR MEASURING THE SIZES AND CONCENTRATION OF LARGE PARTICLES IN CLOUDS AND PRECIPITATION
A. N. Nevzorov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 274–282 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Described is an airborne instrument that uses a photomultiplier to measure the amplitude of electrical pulses caused by particles intersecting a parallel light beam of known thickness. The instrument consists of two main components: a transducer exposed directly to the incident air stream, and a recording unit inside the aircraft cabin. During flight, the particle-laden airstream passes through a pit where it is analyzed by the light beam and from where the pulses are transmitted to an optical recorder for display on charts.
G.G.

N67-22020# Main Geophysical Observatory, Leningrad (USSR).
AIRBORNE AND RADIOSONDE INSTRUMENTS FOR MEASURING RAINDROP SIZE
I. M. Imyanitov, V. V. Mikhailovskaya, and B. F. Evteev *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 283–293 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Described is a radiosonde that uses an acoustic transducer to determine the size of falling raindrops. This transducer consists of a circular receiving plate at the inner side of which are sealed piezoelectric prisms. A telemetering circuit for pulse rate count records droplet size on an oscillograph after the signal is fed to two conversion and amplification channels. The described disdrometer is calibrated by comparing the size distributions of raindroplets from measurements with the instrument, and by the method of colored filtering paper. When falling from a height of 1080 cm, droplets ranging from 0.25 to 2.5 mm create signals varying from 10^{-4} to 2v with the output resistance being 0.5 Mohm.
G.G.

N67-22021# Main Geophysical Observatory, Leningrad (USSR).
A METHOD AND DEVICE FOR DETERMINING THE MICROSTRUCTURE OF CLOUDS AND FOGS
K. S. Shifrin and V. I. Golikov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 294–301 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

An optical method described for determining the microstructure of fogs and large-drop clouds is based on the analysis of a polydisperse system of cloud and fog droplets appearing in dispersion sections with small angle scattering. Size spectra of droplets and spherical powder particles obtained by this and other means were studied by microphotography and compared with the spectra obtained by measuring the regular distribution of light. While the interpretation of data on artificial fogs has not been completed, some conclusions are offered for investigations made between 1958 and 1961. Minimum particle concentration was about 100 to 150 particles per cm^3 and particle size ranged from 2 to 40 microns. Mention is also made of a procedure for the automatic processing of the data obtained.
M.W.R.

N67-22025# Tartu State Univ. (USSR).
DESIGN OF A DYNAMIC CAPACITOR FOR ATMOSPHERIC ION COUNTERS
O. V. Saks *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 324–327 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Advantages are discussed for a dynamic electrometer used in the design of automatic recording atmospheric ion counters. A corrugated bronze membrane proved to be the best electrometer-capacitor, for which the magnetic contour is almost closed and a polarized electromagnet serves as the excitation source. The vibrating system of the capacitor has two resonance frequencies in the 50 to 700 cps band. The drift of contact voltage difference is sufficiently low for use in aspiration-type ion counters. During short intevals, zero drift is negligible; and at the beginning of each cycle, corrections for the zero point can be introduced.
M.W.R.

N67-22026# Main Geophysical Observatory, Leningrad (USSR).
AN IMPROVED METHOD FOR MEASURING THE STRENGTH OF ELECTROSTATIC FIELD NEAR THE SURFACE OF AIRCRAFT FLYING IN THE UPPER ATMOSPHERE
I. M. Imyanitov and Ya. M. Shvarts *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 328–334 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

A method is proposed for the direct measurement of the electrostatic field strength near the surface of craft flying in the upper atmosphere or in interplanetary space. The probe consists of a measuring plate that is connected to the body by a specified resistance, and a shielding plate for protection against space charge. Current interference can make the separation of signal from noise difficult to overcome. Methods of noise suppression are discussed, and it is found that sufficient accuracy results when metallic grid plates with low dielectric inductive capacitance and a relatively high optical transparency are used along with synchronous detection procedures.
M.W.R.

N67-22027# Tartu State Univ. (USSR).
SOME REQUIREMENTS CONCERNING CONDITIONS FOR THE MEASUREMENT OF ATOMOSPHERIC-ION SPECTRA BY THE ASPIRATION METHOD
Ya. Y. Reinet *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 335–344 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

A spectrometer, which operates on the discharge method and has a highly sensitive electrometer with edge effect distortions eliminated, permits the measurement of ion spectra over a wide range of ion mobility. Neighboring points are measured by this aspiration method with constant airflow rate and constant voltage of the measuring capacitor. Special insulation of the inner electrodes reduces charge leakage and insulator polarization. Accurate measurements in a weakly ionized atmosphere, however, are difficult because of the instability of the power source; and redesign of the counter and the connector circuit of the capacitor are necessary to overcome this instability.
M.W.R.

N67-22028# Tartu State Univ. (USSR).
OPTIMUM CHARACTERISTICS OF ASPIRATION COUNTERS OF ATMOSPHERIC IONS
Kh. F. Tammet *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 345–351 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Optimum design parameters are determined for aspiration-type ion counters, and these characteristics are formulated for a given critical mobility in terms of (1) the design that insures the minimum cost for a given characteristic of the device and (2) the

design that insures the optimum characteristics for a given cost. With a given range of critical ion mobilities and limited permissible values of voltage and volumetric flow rate, the sensitivity of the counter will be optimum with a definite capacitance of the measuring capacitor and will deteriorate with either an increase or decrease in capacitance. M.W.R.

N67-22029# Scientific Research Inst. of Hydrometeorological Instruments (USSR).
ON THE PROBLEM OF CHECKING METEOROLOGICAL INSTRUMENTS AND TESTING EQUIPMENT
G. N. Alyanchikova *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 352–356 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Capabilities and limitations of some meteorological instruments are discussed in terms of calibration and testing. Errors resulting from the time lag coefficient for aspiration psychrometers (0.5 min) and psychrometric thermometers (5.0 min) are tabulated, and it is noted that with high rate of temperature variation the readings vary appreciably for the latter type instrument. The aspiration psychrometer gives the same reading at all temperatures between 22.64° and 25.80°C. Low temperature methods used for checking accuracy of meteorological instruments are noted, including the use of the Ranke tube and turbo-expansion equipment in cooling systems. M.W.R.

N67-22030# Main Geophysical Observatory, Leningrad (USSR).
THE STANDARD BAROMETER AND THE USE OF ITS READINGS AT THE NETWORK STATIONS
I. A. Pokrovskaya *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 357–362 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Two mercury barometers that were developed in the late nineteenth century are currently used as the primary standards for atmospheric pressure measurements because they produce errors of less than 0.03 mm Hg. At the GGO, the USSR observatory, these primary standards are being compared with each other and with barometers out in the field; and a new primary standard mercury barometer designed in 1960 is being tested that has a reported root-mean square error of only 0.005 mm Hg. Installation precautions for the standard are discussed, including temperature constancy and stability; and means of further increasing the accuracy of the standard barometer are considered. M.W.R.

N67-22031# All-Union Scientific Research Inst. of Meteorology (USSR).
REFERENCE PISTON BAROMETER
K. I. Khansuvarov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 363–372 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Errors resulting from the use of standard barometers and the main requirements for mercury reference barometers of the stationary siphon-type are discussed, along with the capabilities and potentialities of atmospheric pressure measurement methods. The use of nonsealed piston-type barometers is considered, and the principal components of such instruments are detailed. Because the piston barometer offers the advantages of accuracy, compactness, and ease in handling and transporting, it is feasible for use as a portable reference instrument. Design of the piston barometer permits its true lag coefficient to be varied within a broad range by changing the rigidity of the spring mechanism. M.W.R.

N67-22061*# Eppley Lab., Inc., Newport, R. I.
PYRHELIOMETRIC COMPARISONS AT THE JPL TABLE MOUNTAIN FACILITY
A. J. Drummond and E. G. Laue 15 Dec. 1966 12 p refs Prepared jointly with JPL
(Contract NAS7-100)
(NASA-CR-83271; JPL-TM-33-312) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A series of comparative measurements of various pyrheliometric instruments which were made using natural sunlight are reported. The details introduce instrument calibration techniques for flight and surface radiometers. Methods of observation are also described. Responsibility for instrumental comparisons has been left to the participating organizations. Author

N67-22065*# Kollsman Instrument Corp., Elmhurst, N. Y. Space Div.
HANDHELD SPACE SEXTANT Operating Manual
Jun. 1966 67 p
(Contract NAS2-2706)
(NASA-CR-73072) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The sextant, designed to give an accurate indication of the angle between two optical lines of sight, its operation, and preflight checks and calibrations are described in detail. The mechanical, optical, and electrical systems are discussed, and instructions recommended for use during actual spaceflight are outlined. The parts are illustrated and listed. Also presented are operating, test, and certification procedures for the battery charger and test unit, designed for preflight ground support and test equipment for the sextant. N.E.N.

N67-22098# California Univ., Livermore. Lawrence Radiation Lab.
THEORETICAL CONSIDERATIONS, DESIGN, AND EVALUATION OF A CASCADE IMPACTOR
Jerry J. Cohen and D. N. Montan 20 Jun. 1966 24 p refs
(Contract W-7405-ENG-48)
(UCRL-14440, Rev. 1) CFSTI: HC $3.00/MF $0.65

A cascade impactor of the multi-jet, round-hole design was developed which provides easy alteration of impactor stages and variation of air flow. The instrument was evaluated by empirical observation, correlation of mass distributions of aerosols as determined with the impactor vs membrane filter samples, determination of stage efficiencies and case loss studies. Author (NSA)

N67-22136# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse.
THE GEOMETRIC FIELDS ABSOLUTELY DETERMINED BY THE β-γ COINCIDENCE METHOD [DER GEOMETRISCHE FEHLER BEI DER ABSOLUT-ZAEHLUNG MIT DER β-γ KOINZIDENZMETHODE]
Gerhard Erdtmann Feb. 1965 20 p refs In GERMAN
(JUL-227-CA) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE GEOMETRIC FIELDS ABSOLUTELY DETERMINED BY THE BETA-GAMMA COINCIDENCE METHOD G. Erdtmann 13 p refs (See N67-22137 11-14)
2. THE STATISTICAL FIELDS ABSOLUTELY DETERMINED BY THE BETA-GAMMA COINCIDENCE METHOD G. Erdtmann 3 p refs (See N67-22138 11-14)

N67-22137# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse
THE GEOMETRIC FIELDS ABSOLUTELY DETERMINED BY THE β-γ COINCIDENCE METHOD [DER GEOMETRISCHE FEHLER BEI DER ABSOLUT-ZAEHLUNG MIT DER β-γ KOINZIDENZMETHODE]

Gerhard Erdtmann *In its* The Geometric Fields Absolutely Determined by the β-γ Coincidence Method Feb. 1965 13 p refs (See N67-22136 11-14) CFSTI: HC $3.00/MF $0.65

Beta-gamma absolute measurements on decay rates of radioactive nuclides with counting detectors of large volume, e.g. liquid scintillators, produce an error because the beta and gamma radiation count is location dependent. This error was calculated for a cylindrical probe; it was negligibly small for a nearly symmetrical detector array. Author

N67-22138# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse.

THE STATISTICAL FIELDS ABSOLUTELY DETERMINED BY THE β-γ COINCIDENCE METHOD [DER STATISTISCHE FEHLER BEI DER ABSOLUT-ZAEHLUNG MIT DER β-γ KOINZIDENZMETHODE]

Gerhard Erdtmann *In its* The Geometric Fields Absolutely Determined by the Beta-Gamma Coincidence Method Feb. 1965 3 p refs (See N67-22136 11-14) CFSTI: HC $3.00/MF $0.65

A very brief mathematical description is presented on the statistical error determined by the beta-gamma coincidence method. The scintillator is mentioned as the radiation detector. Transl. by R.L.I

N67-22139# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorbauelemente.

GAMMA SPECTROMETRY WITH SEMICONDUCTOR DETECTORS [GAMMA-SPEKTROMETRIE MIT HALBLEITERDETEKTOREN]

G. Riepe and H. Petri Oct. 1965 18 p refs In GERMAN; ENGLISH summary

(JUL-306-RB) CFSTI: HC $3.00/MF $0.65

Lithium-drifted germanium and silicon semiconducting detectors were compared with a thallium-activated sodium iodide crystal scintillation counter in a multiple channel spectrometer for gamma spectrometry. Observed were absorption probability, resolution, and time constant of the rising pulse. Obtained resolution values proved the germanium lithium detector superior to the scintillation counter; but absorption ability remained behind the performance of the sodium iodide crystal. The time constant of the rising pulse for the germanium sensor was about 10 times shorter than that for the sodium iodide counter. Transl. by G.G.

N67-22140 Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente.

PREPARATION OF A β-γ COINCIDENCE APPARATUS FOR THE ABSOLUTE DETERMINATION OF THE STRENGTH OF SOURCES (SPECIAL APPLICATION OF ACTIVATED GOLD FOIL) [EINRICHTUNG EINER β-γ KOINZIDENZAPPARATUR ZUR ABSOLUTBESTIMMUNG RADIOAKTIVER QUELLSTAERKEN (SPEZIELL ANGEWANDT AUF AKTIVIERTE GOLDFOLIEN)]

W. Schneider Mar. 1964 36 p refs In GERMAN

(JUL-187-RX0 CFSTI: $3.00

Reported are construction, evaluation, and control measurements with a beta-gamma coincidence spectrometer, designed to measure the radioactive strength of gold^{198} in gold foils of 20μ thickness and ≤ 1 cm^2 diameter. The absolute neutron flux determination as well as the performance calibration in the development program for the Fast Reactor Juelich-2 were based on these measurements. The activation measurement scale for the disk sensors covered 0.002 to 1μC with an error of about $\pm$2% under favorable conditions. Author

N67-22257*# Advanced Technology Labs., Mountain View, Calif.

HIGH-ALTITUDE-LIMITATION STUDY ADVANCED HORIZON SENSOR FOR OGO Final Report, 4 Apr.–15 Jul. 1966

R. K. Ronald 30 Aug. 1966 100 p refs

(Contract NAS5-9109)

(NASA-CR-83567; ATD-R-1405) CFSTI: HC $3.00/MF $0.65 CSCL 17H

High-altitude or small-earth limitations are investigated for the advanced horizon sensor of the Orbiting Geophysical Observatory, OGO-A. Small-earth limitation is considered as the extreme nonlinearity in the three-tracker mode of attitude angle calculation when the earth disk subtends a small angle; and it is shown that at a satellite altitude of more than 80,000 nautical miles, a reliable maximum pitch-attitude angle of only one degree results and the tracking-check logic breaks track when the horizon temperature is less than 214°K. Effects of finite field of view of the infrared beam, dc offset, and horizon temperature on the tracking point are considered; while small-earth climatic variations are excluded. Horizon-convolution and horizon-gradient tracking computer programs are discussed; and summing-amplifier output accuracy as well as space bias and square-earth effect are considered. Optical characteristics of the OGO-A telescope, transfer functions, numerical values for circuit constant, and a space-bias study are treated. M.W.R.

N67-22327# California Univ., Livermore. Lawrence Radiation Lab.

DEVELOPMENT AND APPLICATION OF THE INTRINSIC THERMOCOUPLE FOR FAST RESPONSE

Gerald R. Dittbenner Mar. 9, 1966 11 p refs

(Contract W-7405-ENG-48)

(UCRL-14593) CFSTI: HC $3.00/MF $0.65

Fast-response thermocouples were developed by LRL to measure the temperature-time history of fissionable materials subjected to a pulsed neutron flux. The thermocouples were made of 0.001-in. and 0.0005-in. wire, flattened to a 200-μin.-thick ribbon. The two wires of each thermocouple are individually welded to the test specimen about 1/32 in. apart so that the specimen completes the circuit and forms an intrinsic thermocouple installation. The 0.0005-in. thermocouple will stabilize at a normal indicated 100% of the test sample temperature in less than 1 msec after a quasi-step temperature change. This corresponds to an estimated time constant (63% of peak temperature) of about 20 μsec. Author (NSA)

N67-22358 Joint Publications Research Service, Washington, D. C.

METHODS AND INSTRUMENTS FOR MARINE RESEARCH

A. N. Paramonov, ed. 13 Feb. 1967 230 p refs Transl. into ENGLISH from the book "Metody i Pribory Dlya Issledovaniya Fizicheskikh Protesessov v Okeane" Kiev, Izd. Naukova Dumka, 1966 p 38–141, 146–198, 202–214

(JPRS-39881; TT-67-30529) CFSTI: $3.00

Articles on techniques and instruments for measuring the temperature, optical density, salt content, electrical conductivity, depth, and current velocity of sea water are presented. For individual titles see N67-22359–N67-22379.

N67-22359 Joint Publications Research Service, Washington, D.C.

HYDROACOUSTIC SYSTEM FOR TELEMETERING TRANSPARENCY OF SEA WATER

A. N. Paramonov, G. G. Neuymin, V. I. Man'kovskiy and Yu. A. Prokhorenko *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 1–16 refs (See N67-22358 11-14) CFSTI: $3.00

Technical details are presented on a marine pulse-type photometer transparency meter with the submerged transparency pickup acoustically connected to a recorder aboard the vessel. A block diagram of the apparatus is included, and the specifications for each subsystem are defined. These include the optical,

photoelectronic, and coding units; emitters; communication channel; receiving–amplification unit; and the decoding and recording units. The methods for calibrating the instrument and analyzing the measurement results are discussed. M.G.J.

N67-22360 Joint Publications Research Service, Washington, D.C.

MULTIPASS PHOTOMETER-TRANSPARENCY METER

G. G. Neuymin, Ye. A. Agafonov, and S. V. Karaush *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 17–25 refs (See N67-22358 11-14) CFSTI: $3.00

The advantages of the described transparency meter are cited as its capability to make measurements directly in the sea at depths up to 300 m, and of transparency both in integrated white light and in some narrow spectral bands. The optical system is based on the principle of multiple reflection of the light ray from three spherical mirrors with an identical radius of curvature; this makes it possible to change the length of the optical path of the light in the water. In constructing the photoelectric measurement system, a precise differential principle was used, with alternate comparison of the reference and measuring beams in a single photoreceiver with a feedback for the light flux. This operates in a zero indication regime. The operating model consists of a deck part (control panel, automatic recorder, and current source), a connecting cable, and a submergible part. Preliminary test data are included. M.G.J.

N67-22361 Joint Publications Research Service, Washington, D.C.

A DIGITAL METHOD OF COMPUTING THE POSITION OF A PHOTOMETRIC WEDGE WHEN MEASURING THE OPTICAL DENSITY OF SEA WATER

A. N. Paramonov, V. M. Zaikin, G. A. Tolkachenko, and M. Ye. Lu *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 26–35 refs (See N67-22358 11-14) CFSTI: $3.00

Based on the assumption that for each measurement cycle there are cadence and measuring pulses reflecting the current value of the input analog value, a device is described for converting the angular position of the wedge into the digital equivalent of the measured parameter. Such a conversion differs from time interval–code conversion in that the inconstancy of the wedge's rotation rate exerts no influence on measurement accuracy. The converter operates on the principle of counting individual increments of the input analog value in each conversion cycle. A digital pulse code is used as it satisfies the requirements of measurement speed and accuracy, and makes possible the technical realization of a measuring circuit with good noise immunity in information transmission through the communication channel. M.G.J.

N67-22362 Joint Publications Research Service, Washington, D.C.

MARINE POLARIMETER-BRIGHTNESS METER

M. N. Kaygorodov and G. G. Neuymin *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 36–53 refs (See N67-22358 11-14) CFSTI: $3.00

To further improve methods for measuring polarization and obtaining higher quality experimental data, a model of a marine automatic polarimeter–brightness meter was developed. The instrument complex includes a submerged part, a control panel, a gauge for measuring illumination above water, and a current source. The submerged part consists of three individual containers joined into a common kinematic system. Measurement results are recorded by a loop oscillograph. Operational principles are detailed, and measurement methods are described. The data obtained are analyzed, and it was concluded that the meter can be used successfully in different regions of the sea and ocean. M.G.J.

N67-22363 Joint Publications Research Service, Washington, D.C.

METHOD FOR WORKING WITH CONTACTLESS LABORATORY SALINOMETER UNDER EXPEDITIONARY CONDITIONS

Yu. V. Pavlenko *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 54–58 refs (See N67-22358 11-14) CFSTI: $3.00

Problems associated with the adjustment and operation of electric salinometers for determining salinity are discussed, and design details are presented on a model which was tested aboard a research vessel. Factors which influence the accuracy are identified as (1) instability of the shipboard supply voltage; (2) oscillations of the indicator hand at the time of rolling due to inadequate damping; (3) formation of air bubbles during pouring of the sample; (4) instability of the thermistor resistance with time; and (5) fluctuation of the resistance of the contact connections due to increased humidity. The point is made that neglecting small but often significant requirements leads to considerable discrepancies between the computed and real characteristics of the instrument. M.G.J.

N67-22364 Joint Publications Research Service, Washington, D.C.

INDUCTION SALINOMETER WITH BINARY CODE READOUT

L. M. Antonova and V. I. Zaburdayev *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 59–70 refs (See N67-22358 11-14) CFSTI: $3.00

A complex of measuring instruments has been developed whose output information is expressed in the form of a binary code. Details are given on a salinometer, one of the instruments in this complex which, together with pressure and temperature gauges and a system for data transmission along a single strand cable, is included within a submergible apparatus. Salinity determinations and conversion of its values into a binary code is accomplished by a servo system whose circuit includes an electrical conductivity pickup, an unbalance signal amplifier, a circuit for controlling reversing buses, a phase discriminator, a reversing binary counter, and a code–conductance converter. Each is described in detail. The instrument has an independent current source rated for eight hours of continuous operation. M.G.J.

N67-22365 Joint Publications Research Service, Washington, D.C.

NEW DESIGN OF A CONTACTLESS PICKUP FOR DETERMINING ELECTRICAL CONDUCTIVITY OF SEA WATER

Yu. V. Pavlenko and G. N. Khristoforov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 72–79 refs (See N67-22358 11-14) CFSTI: $3.00

Operational calculus methods are used to write the equations of the circuit currents of a simplifed equivalent circuit of a pickup; these are applicable to quadripoles. The design of an electrical conductivity sensor is also described. Ferrite materials, with a greater resistance to mechanical effects, were used for the magnetic leads. The resonance connection of the sensor ensured a high transfer coefficient, despite the small magnetic permeability of the ferrites. It also eliminated some undesirable effects associated with the specific magnetic characteristics of the materials used. Electrical conductivity tests of the apparatus indicated that the sensors have a high degree of reliability. M.G.J.

N67-22366 Joint Publications Research Service, Washington, D.C.

TEMPERATURE MEASUREMENTS OF THE OCEAN SURFACE FROM A MOVING VESSEL

I. L. Isayev, M. F. Naumenko, K. I. Chigrakov, and A. P. Shumov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 80–85 refs (See N67-22358 11-14) CFSTI: $3.00

Low inertia apparatus for measuring surface temperatures is described, and the method for making measurements under natural conditions is discussed. Small semiconductor thermoresistors with a relatively high temperature coefficient and a small time constant are used. A schematic representation of the temperature sensor shows the thermal attachment, protective covering nut, housing, rubber gasket, lock nut of gasket, and rubber packing ring. Its design makes rapid replacement of thermal attachments possible, and ensures measurement reliability over a long period. The bridge circuit design is in the form of an attachment to the recording instrument. Three variants of sensor placement were tested on a moving vessel. The relative advantages of each are assessed in relation to weather conditions. M.G.J.

N67-22367 Joint Publications Research Service, Washington, D.C.

SOUNDING THERMOMETER WITH ELEVEN FREQUENCY BANDS

V. M. Oshanin, S. V. Dotsenko, A. A. Yeroshko, and Yu. I. Utenkov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 86-105 refs (See N67-22358 11-14) CFSTI: $3.00

In the frequency thermometer described, the proposed circuitry design provides for the use of a single strand cable and low inertia temperature sensors (resistance thermometers), which have the advantage of linearity. For increased measurement accuracy, a circuit employing narrow range bridges and range switching was selected. Operation, based entirely on semiconductors, is completely automated. The submergible part of the thermometer complex consists of a temperature channel generator, integrator, output amplifier, circuit for automatic range switching, range indicator generator, pressure channel generator, and current source. The purpose and interaction of each are considered. The shipboard apparatus is designed for decoding and recording the information arriving through the cable. Three devices for converting frequency into voltage are included. It is reported that the instrument can trace the temperature fluctuations at a given horizon, and measure temperature variations having a frequency up to 2 cps with an accuracy of ±0.02°C. M.G.J.

N67-22368 Joint Publications Research Service, Washington, D.C.

SOUNDING THERMOMETER WITH INDUCTION DEPTH SENSOR

V. M. Oshanin *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 106–109 (See N67-22358 11-14) CFSTI: $3.00

An induction pressure sensor and a two-coordinate recorder adapted for temperature and depth measurements were incorporated into the design of a sounding thermometer. The apparatus has the capability for submergence to a depth of 750 m. The operation of the differential circuit is depicted and described. As measurements are made every three, five, or ten minutes, depending on the depth of submergence, a high speed cable winch is used to lower the instrument. The cable is hauled aboard first and attached to the recorder. Measurement accuracies were obtained to 0.1°C for temperature, and up to 3 m for depth. M.G.J.

N67-22369 Joint Publications Research Service, Washington, D.C.

BATHYTHERMOMETER

S. S. Gapamadzhyan *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 110-116 refs (See N67-22358 11-14) CFSTI: $3.00

To measure the temperature of sea water to a depth of 1200 m with an accuracy to 0.05°C, a copper resistance thermometer was used as the sensor in the instrument. Although the temperature resistance coefficient for such a sensor is considerably lower than for thermistors, its advantages are considered to be stability of the resistance value in time, a small dependence of the resistance value on pressure, and a linear dependence of resistance on temperature. A schematic and circuit diagram for converting the resistance value of the sensor into dc voltage are shown. The voltage, which is converted into a binary code, is transmitted along a single strand communication cable and is registered aboard the ship on a magnetic tape using an automatic analog recorder. The unit can also operate with devices for converting the angle of rotation or resistance into a code; in this case there is no need for fabricating a high quality dc voltage stabilizer. M.G.J.

N67-22370 Joint Publications Research Service, Washington, D.C.

USE OF THERMISTORS FOR MEASURING TEMPERATURE FLUCTUATIONS IN THE SEA AND IMPROVEMENT OF TECHNOLOGY OF PRODUCING MULTIJUNCTION THERMOCOUPLES

A. D. Zhokhov and I. I. Gromova *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 117–124 refs (See N67-22358 11-14) CFSTI: $3.00

Problems involved in hydrophysical research are discussed, with consideration given to the necessity of standardizing measurement methods. Several types of thermoelectric sensors are assessed in relation to their sensitivity. A technical plan, developed for producing individual independent elements each with 30 to 50 junctions, is described. The method depends on precise adherence to the computer parameters of the thermoelectrodes, and to the volume and geometrical dimensions of the inert part of the element, fabricated from heat insulating material, in which the closed junctions of the sensors are placed. An experiment in fabricating thermoelectric sensors by the pressing method yielded positive results, and confirmed the feasibility of the proposed instrumentation. M.G.J.

N67-22371 Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS OF MEASURING CURRENT VELOCITY BY THE DOPPLER METHOD

V. I. Babiy *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 125–143 refs (See N67-22358 11-14) CFSTI: HC $3.00

Equations are derived for determining current velocity based on the recording of the Doppler shifts of frequency in radiation scattered by the water. Attention is also focused on several variants of Doppler current velocity gauges. These include (1) a single component gauge based on the principle of synchronous reception; (2) an apparatus for recording the transverse fluctuations of current velocity, using the principle of autocorrelated reception; (3) an instrument for investigating the spatial correlation of the velocity field; (4) a gauge using noise radiation for obtaining spatial selectivity; and (5) an apparatus for detecting Doppler shifts of frequency in scattered light. M.G.J.

N67-22372 Joint Publications Research Service, Washington, D. C.

EQUIPMENT FOR FINDING ANCHOR BUOY STATIONS

A. S. Vasil'yev and V. S. Nazarov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 144–149 refs (See N67-22358 11-14) CFSTI: $3.00

Shipboard radar apparatus, a passive reflector mounted on the buoy, a buoy radio transmitter, and signal lights which usually flash are used to locate anchored buoys. Apparatus is proposed which radiates two signals: one is longer, and the second brighter but shorter. Electronic circuits are used to increase operational reliability. Details are also given on a small, transistorized buoy radio transmitter, constructed in two units: a current source

with a coding system placed inside the buoy, and a container with the transmitter circuit attached to the upper part of the antenna mast. M.G.J.

N67-22375 Joint Publications Research Service, Washington, D.C.

DEVICE FOR VISUAL READOUT OF BINARY DATA

A. V. Khokhlov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 164–170 refs (See N67-22358 11-14) CFSTI: $3.00

To permit direct observation of measurement results at the time of the experiment along with a check on the output information being fed into the digital computer, an apparatus was developed for decoding information in a binary code and converting it into a convenient form for visual readout. Block and time diagrams of the visual readout device are presented. Design and operational data are detailed. Semiconductor pulse–potential elements, designed in the form of moduli, are used in constructing the apparatus. The instrument is operational in the temperature range from −10° to +50°C. M.G.J.

N67-22376 Joint Publications Research Service, Washington, D.C.

MAGNETIC RECORDER FOR RECORDING DATA FROM HYDROPHYSICAL INVESTIGATIONS

V. F. Sytnikov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 171–176 refs (See N67-22358 11-14) CFSTI: $3.00

Descriptive data are presented on a magnetic recorder designed for use in a shipboard telemetric system. Operational duration is 8 to 10 hours; the volume of information is 8.105 binary digits; and input is received in the form of a systematic binary code. The frequency method of regulating motor speed was selected to ensure a constant linear tape speed during recording at 2 cm/sec, and a smooth change of speed during reproduction from 2 to 20 cm/sec. This control is accomplished in the magnetic recorder, consisting of a generator, a key frequency divider, a preamplifier, a power amplifier, and a motor. Advantages of the recorder are cited: (1) The recording time with a magazine holding a tape 500 m in length is 7 hours. (2) Density of pulse recordings per 1 mm of tape length is 20 binary digits. M.G.J.

N67-22377 Joint Publications Research Service, Washington, D.C.

SYSTEM FOR RECORDING AND REPRODUCING INFORMATION ON MAGNETIC TAPE BY THE METHOD OF FREQUENCY MODULATION

V. I. Antonov, V. I. Babiy, and V. K. Kupriyanov *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 177–184 (See N67-22358 11-14) CFSTI: $3.00

Based on the frequency modulation method and the simultaneous recording of a pedestal frequency, a system was developed for continuous recording and accelerated reproduction of data on a magnetic tape. The system is a variant of a recording apparatus designed for deep sea autonomous hydroacoustic sea current velocity meters operating on the Doppler effect principle. Its selection is attributed to the fact that the output signal of the Doppler hydroacoustic current velocity sensor is a frequency modulated voltage caused by the Doppler shift of frequency. The apparatus consists of an autonomous recording device housed in a deep water container, and station equipment for accelerated reproduction of the measurements. Basic data on the system and the test results are presented. M.G.J.

N67-22378 Joint Publications Research Service, Washington, D.C.

INSTRUMENT FOR DETERMINING THE RANGE OF DEPTHS DURING THEIR MEASUREMENT USING THE "LADOGA" RECORDER

Yu. V. Terekhin and V. F. Shermazan *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 185–191 refs (See N67-22358 11-14) CFSTI: $3.00

A range indicator instrument was developed and constructed for use as an attachment to the phototelegraphic recorder. Its operational principle involves a reading of the time between the transmitted pulse and the echo signal. The device is constructed on a separate duralumin base, to which the electrical timer is attached. On the rear wall of the timer is a plate, on which the limiter, amplifier and special multivibrator, differentiating circuit with limiter, and trigger are mounted. The front panel has a window for the timer scale, signal and trigger buttons, a toggle switch for cutting in the instrument, and a hand regulator for the limitation level. Extremely small tubes and transistors were used in the circuit. Reliability tests show that the error was not greater than 0.02 sec in 99% of the measurements. M.G.J.

N67-22379 Joint Publications Research Service, Washington, D.C.

DEVICE FOR MEASURING TURBULENT FLUCTUATIONS OF CONDUCTIVITY AND TEMPERATURE OF SEA WATER

G. N. Khristoforov and G. Yu. Aretinskiy *In its* Methods and Instr. for Marine Res. 13 Feb. 1967 p 192–201 refs (See N67-22358 11-14) CFSTI: $3.00

Design efforts were directed toward improving the operational characteristics and increasing the degree of automation of an instrument for recording turbulent fluctuations of electrical conductivity and temperature in situ. The instrument consists of a control panel with a recorder placed aboard the vessel, and a measuring circuit placed underwater in a sealed container. A 7-strand cable connects the two parts. The electronic circuit, which has an independent current source, is composed of transistors and semiconductor diodes. Calibration procedures are given. Test results are evaluated, and the recommendation is made that the time constant of the temperature channel should be decreased to at least 0.02 sec. M.G.J.

N67-22390# Union Carbide Corp., Oak Ridge, Tenn.

INDUSTRIAL INTERFEROMETRY

L. G. Whitten 7 Dec. 1966 38 p

(Contract W-7405-ENG-26)

(Y-1559) CFSTI: HC$3.00/MF$0.65

After three-hundred years, the science of interferometry is being accepted in industrial environments. Its progress has been slow, but it is now a useful shop tool. It can be used for the measurement of linear distance, straightness, flatness, and surface finish. It is adaptable to use either as the control the feedback of tape-controlled machine position. Author (NSA)

N67-22472 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

DESIGN OF A 20 C.P.S.–20,000 C.P.S. PASS BAND ANALOG CORRELATOR WITH A CONTINUOUSLY ADJUSTABLE TIME DELAY BETWEEN 0 AND 0.1 SECOND. [ETUDE D'UN CORRELATEUR ANALOGIQUE DE BANDE PASSANTE 20 Hz–20,000 Hz ET DE RETARD REGLABLE CONTINUEMENT DE 0 A 0.1 SECONDE]

Robert Hervé 1966 88 p refs

(TN-103(1966)) CFSTI: $3.00

The originality of this analog correlator is found in the use of a continuously variable time-delay system associated to a discrete time-delay system. Such a solution permits the definition of functions of large time-delay autocorrelation and of crossed correlation from an important and precise initial value. Following a brief survey of the properties of random functions and the description of some existing correlators it is shown that a study of the solution adopted leads to well defined characteristics of the system. The construction of a simplified equipment has provided the means to verify the principle and to solve some practical problems. Author

N67-22505# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECTS OF CHROMATIC ASTRONOMICAL REFRACTION ON THE GUIDING OF A LONG FOCUS TELESCOPE
O. A. Mel'nikov, G. G. Lengauer, and N. F. Kuprevich *In its* Pulkovo. News of the Astron. Obs. 17 Jun. 1966 p 1–49 refs (See N67-22504 11-30) CFSTI: HC $3.00/MF $0.65

The refraction of objects with anomalous continua and intensive radiation in the ultraviolet portion of the atmospheric spectra is considered. The system of isophote lengths is compared with other systems of wavelengths which are sometimes used when calculating refraction. A method is developed for calculating the average photometric and energetic fluxes from stars in the focal plane of a telescope. On the basis of the best available determinations of air refraction, tables are computed for the differential chromatic refraction for objects with different radiation components under various conditions. For application to measuring differential chromatic refraction, an attempt was made to contain by means of a television telescope very large scale star photos (equivalent focal distance 465 m). R.Li.

N67-22508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FAST, WIDE ANGLE TELESCOPE OF LARGE DIAMETER
T. S. Belorossova, D. D. Maksutov, N. V. Merman, and M. A. Sosnina *In its* Pulkovo. News of the Astron. Obs. 17 Jun. 1966 p 95–104 refs (See N67-22504 11-30) CFSTI: HC $3.00/MF $0.65

Data for the optical system, structural elements and aberration of a fast wide angle telescope with D=2.6 m and A=1:3.67 are given. The telescope is a hyperboloid with a four-lens, afocal corrector in the convergent light beam. Photographs are made on 310x310 mm plates. Author

N67-22513*# Arizona Univ., Tucson.
A DEVICE FOR DETERMINING THE INSTANTANEOUS FOCAL LENGTHS OF LARGE TELESCOPES
D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 13–16 (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

An instrument for the rapid determination of focal length is described. This is a plateholder that oscillates the plate in declination so as to obtain sinusoidal star trails. The methods of reduction of the measures for focal length are described and the precision is estimated as one part in 30,000 for good seeing with long-focus refractors. Author

N67-22526# Avco Corp., Wilmington, Mass. Research and Technology Labs.
SPECTROMETER FOR ATMOSPHERIC IONS IN THEIR UPPERMOST RANGE MOBILITY, PHASE II Final Report
H. Dolezalek and A. L. Oster 30 Sep. 1966 57 p refs
(Contract DA-19-020-AMC-0058(X))
(AVSSD-C200-66-RR; AD-645457) CFSTI: HC $3.00/MF $0.65

As a continuation of Phase I (AD-638 761) of the final report, Phase II presents supplements for the theoretical considerations on the measurement of mobility spectra of atmospheric ions in the upper troposphere, stratosphere, and mesosphere. A preliminary evaluation of three free-air measurements in the height range from 5 to 40 km is discussed. The design of a new model (C) of the modified GERDIEN chamber for the height range from 40 to 80 km is described, applying the ac operation mode developed by the authors. Author (TAB)

N67-22538# Army Electronics Labs., Fort Monmouth, N. J.
PERFORMANCE CHARACTERISTICS OF TWO HEWLETT-PACKARD ATOMIC Cs BEAM FREQUENCY STANDARDS
Clarence E. Searles Dec. 1966 31 p refs
(ECOM-2783; AD-645752) CFSTI: HC $3.00/MF $0.65

Two commercial Hewlett-Packard Company all solid-state, atomic cesium beam frequency standards, Model 5060A, Serial Nos. 103 and 109, adjusted to the UT-2 1965 time scale (150 x 10 to the minus 10th power have been under evaluation since 9 November 1965. This report describes the Hewlett-Packard atomic frequency standard and includes information on its performance capabilities. Stability measurements were performed by comparing the output frequency of the No. 103 and No. 109 against each other and against other atomic frequency standards. In March 1966 both standards were modified to the UT-2 1966 time scale (300 x 10-10). Stability with respect to the environments of 0C to 50C temperature and 5-33 cps, 0.01 in. D. A. vibration was better than 5.0 x 10 to the minus 12th power and 1.0 x 10 to the minus 11th power respectively. Stability at room temperature was consistently better than 0.05, however, there were four beam tube failures in a four-month period. The beam tube manufacturer, Bomac Company - a subsidiary of Varian Associates - claims that they have isolated the difficulty and subsequent beam tubes would be reliable. Author (TAB)

N67-22568# Harry Diamond Labs., Washington, D. C.
A PRECISION 10-Hz CLOCK FOR MILITARY ELECTRONIC TIMERS
M. J. Katz, J. M. Shaull, and J. W. Miller, Jr. Nov. 1966 29 p refs
(HDL-TM-66-17; AD-645878) CFSTI: HC $3.00/MF $0.65

A precise clock suitable for providing pulses to counting circuits in an electronic timer is described. The clock consists of an accurate 810-Hz twin-T oscillator, a wave shaper, and four stages of ternary dividers. Also described are circuits to inhibit the dividers from giving clock pulses until the counting circuits are ready to accept them and to set the dividers initially to compensate for the power supply rise time. The clock exhibits a frequency stability of plus or minus 0.05 percent over the temperature range-55 to +71C. The clock is expected to maintain this stability after 30,000-g linear acceleration and during 35,000-rpm spin. Limited air gun and field tests indicate that the clock will maintain its stability in this environment. Author (TAB)

N67-22569# Xerox, Rochester, N. Y.
ELECTROSTATIC IMAGING Final Report
James O. Dyal Dec. 1966 65 p refs
(Contract Nonr-4912(00))
(AD-646037) CFSTI: HC $3.00/MF $0.65

The report presents the results of a study program on the application of electrostatic imaging to naval systems. Electrostatic imaging and variations of the process are detailed, and particular applications for both seaborne and land-based installation are described. Applicable areas studied and reported include large screen displays, special instrumentation, microfiche and CRT-computer printout systems. TAB

N67-22578# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
A CLOUD DROPLET CAMERA
K. Itagaki Nov. 1966 17 p refs
(CRREL-TR-185; AD-645959) CFSTI: HC $3.00/MF $0.65

The problems encountered in measuring the size distribution of water droplets by impactor may be solved by making in situ photographs of air-suspended droplets. Exposure must be sufficiently short to stop the moving droplets and is accomplished by using electronic strobes having a nominal duration of about 1.2 microsec at medium range. The almost linear relationship, up to 200 microns, between actual droplet size and ring diameter was determined from photographs of droplets suspended by fibers and droplets produced by an atomizer. Camera and impactor results of size

distribution in atomizer generated fog, steam fog and natural fog are summarized. Comparing the advantages and disadvantages of previously developed photographic, electronic, and laser apparatus the present procedure may result in a standard method of cloud or fog observation. Author (TAB)

N67-22584# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
ANALYTICAL AERIAL TRIANGULATION WITH LARGE COMPUTER (ANALYTICAL SIMULTANEOUS BLOCK TRIANGULATION TECHNIQUE) Interim Technical Report, 23 February 1960–1 April 1963
Robert A. Matos Oct. 1966 140 p refs
(TR-34-TR; AD-645639) CFSTI: HC $3.00/MF $0.65

The report describes the development and results of testing a simultaneous analytical aerial triangulation and adjustment techniques programmed for a large scale, general purpose, electronic digital computer. The technique is an outgrowth of the intersection equations developed by Dr. Paul Herget and induces weight procedures prepared by Mr. D. Brown. The technique is unrestricted as to camera type, geographic location, number of photographs, or flight configuration. The computer program is coded in FAP for the IBM 704, 709, 7090 and 7094. The program will solve up to 28 photographs simultaneously. Engineering test configurations and test results using this program from February 1960 to April 1963 are reported. Author (TAB)

N67-22591# Wilcox Electric Co., Inc., Kansas City, Mo.
DESIGN AND DEVELOPMENT OF A CATEGORY III ILS MONITOR Final Report
Neal Owens Nov. 1966 98 p
(Contract FA-WA-4453)
(SRDS-RD-66-94; AD-646143) CFSTI: HC $3.00/MF $0.65

The object of the project was to develop a receiver type monitor to operate as an integral part of the proposed Federal Aviation Agencys All-Weather Landing System. The monitor was designed with optimum reliability, flexibility, and stability in order to attain the highest degree of safety for aircraft operating to the lowest minimal. The most advanced techniques within the state of the art were employed within the monitor. Also, the monitor was designed so that it could be incorporated into either the localizer or glide slope system. Each monitor system is composed of three units, with one unit containing the rf-if-detector circuits, one unit containing the audio and alarm circuitry, and the third consisting of the monitor power supply. The audio and alarm unit is identical for both localizer and glide slope operation, whereas the rf-if-detector units have been specifically designed for localizer or glide slope respectively. The ILS Monitor was evaluated for performance, and the final design thoroughly tested. Author (TAB)

N67-22663*# Massachusetts Inst. of Tech., Cambridge.
COGNITIVE INFORMATION PROCESSING
W. L. Black, M. Eden, T. S. Huang, F. F. Lee, S. J. Mason et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 287–309 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Grants NsG-496; NIH 2-PO1-MH-04737-06; NSF GK-835; Contract DA-36-039-AMC-03200(E))

Papers are presented on research in the real-time acquisition and processing of visual information for display to the visual and nonvisual senses for communication and control. Topics reported include: reproduction of black and white graphical data by facsimile using a continuous tone scale; image transmission by two-dimensional contour coding; Fourier transform representation of pictures, in which the Fourier series is determined for a periodic, two-dimensional, discrete function; the effect of multipath on hologram television systems; and coherent spatial matched filters to extract range and Doppler information from a radar or radarlike signal recorded on photographic film. Research on the related fields of reading machines, picture processing, pattern recognition, and biological image processing are summarized. N.E.N.

N67-22721# Naval Radiological Defense Lab., San Francisco, Calif.
COLOR FILMS FOR MEGARAD DOSIMETRY
Cirel K. Menkes and Norman Goldstein 13 Oct. 1966 50 p refs
(USNRDL-TR-1097; AD-646010) CFSTI: HC $3.00/MF $0.65

Dyed color films manufactured for theatrical lighting have been tested for dosimetric response between 100,000 and 10 to the 8th power roentgens. Optical density for 61 colored films as a function of wavelength was measured before and after an exposure of 50 million roentgens. Based on the sensitivity and stability of the 61 exposed films, two were investigated for change in optical density at an optimum wavelength as a function of exposure value. The effect of storage temperature was also investigated for one of the films. Author (TAB)

N67-22769*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CALIBRATION OF THE SIX-FOOT SPHERICAL INTEGRATOR
E. I. Mohr (Columbia Union Coll.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 399–407 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

For possible use as a wide angle source for the calibration of radiometers in the visible and near infrared regions, a six-foot spherical integrator was purchased. It was then calibrated, based on the use of the Eppley water-cooled thermopile 4928A. Subsequent investigations indicated decided differences in the response of the thermopile to a standard quartz-iodine lamp and to a blackbody operated at various temperatures. These differences in the response of the thermopile to various sources indicate that the calibration of the spherical integrator by means of the thermopile is in doubt. R.L.I.

N67-22770*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A HIGH RESOLUTION SPECTROMETER FOR MEASURING ABSORPTION CROSS-SECTIONS BETWEEN 1000 A AND 2000 A
J. H. McElaney (Fairfield Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 409–415 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Of interest for atmospheric physics studies, the absorption cross-sections of vacuum ultraviolet radiation by various gases between 1000A and 2000A were studied with a high resolution spectrometer. A compilation of experimental results on this topic up to 1962 is cited. The literature survey provides technical details of the spectrometer. R.L.I.

N67-22772*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EVALUATION OF THE CONE RADIOMETER
John M. Crowell, Donald L. Henry, and Edward D. Reed *In its* 1966 Session of the Goddard Summer Workshop [1967] p 429–438 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Two wire-wound cone radiometers were used in experiments with two different types of enclosures for the cones. The resistance of a cone is temperature dependent. This phenomenon allows the cone to be used for absolute measurements of incident light flux by calibrating the cone with respect to resistance with I^2R heating, provided the temperature of the cone enclosure remains constant. The two enclosures tested were a heated copper jacket and an evacuated copper jacket cooled with circulating ice water. Measurements of the flux from standardized quartz-iodine tungsten

lamps were taken. Also discussed are heated jacket design, and cooled jacket design. R.Ll.

N67-22773*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CALIBRATION OF WORKING STANDARDS OF SPECTRAL IRRADIANCE FOR LABORATORY USE
Arthur McNutt, Jan Slavin, and Matthew P. Thekaekara *In its* 1966 Session of the Goddard Summer Workshop [1967] p 439-445 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

For measuring the spectral irradiance of other unknown sources, various standards of calibration are reviewed. Experimental procedure was directed toward calibrating four commercial 1000 watt quartz iodine lamps using two NBS (National Bureau of Standards) standard lamps. Total irradiance measurements are presented, and tabular data indicate regions where measurements were made, the slit width, and the detector employed. Technical details are also presented on: weighted averages of compared measurements, radiance of standard lamps based on thermopile measurements, and total absorptance of typical spectrally sensitive surfaces when exposed to high pressure xenon arc. R.Ll.

N67-22779*# IIT Research Inst., Chicago, Ill.
SURVEY OF DETECTORS AND DYNAMIC CALIBRATION METHODS FOR REMOTE SENSING SYSTEMS
G. Johnson and A. J. Montgomery Washington, NASA, Apr. 1967 108 p refs
(Contract NAS8-20107)
(NASA-CR-751) CFSTI: HC $3.00/MF $0.65 CSCL 14C

The objective of this survey was to provide the data required to choose optimum detectors and calibration systems for use in crossed-beam, cross-correlation measurements. In this application, a pair of intersecting or skew light beams is employed as a non-interfering probe for mapping local thermodynamic properties and turbulent flow characteristics. Detectivity therefore is a parameter of primary concern. Since precision of measurement of correlation function R is a function of light intensity as well as of detectivity, detector signal/noise ratios are presented graphically and algebraically as functions of mean input to the detector. To use these data, mean input is computed from information about a particular source, turbulent fluctuations, and spectrometer, and S/N is obtained from the graphs or equations. Log-log graphs are used to show slope discontinuities marking successive transitions between dominance of detector noise, signal shot noise, and uncorrelated turbulence noise. Tabulations of mean intensities at these transitions and equations for their calculation are included in the text. Author

N67-22780*# American Science and Engineering, Inc., Cambridge, Mass.
A PROGRAM OF HIGH ANGULAR RESOLUTION STUDIES OF CELESTIAL X-RAY SOURCES
H. Gursky, R. Giacconi, P. Gorenstein, H. Manko, and J. R. Waters Washington, NASA, Apr. 1967 38 p
(Contract NASw-1505)
(NASA-CR-752) CFSTI: HC $3.00/MF $0.65 CSCL 14C

An Aerobee rocket experiment is described which has as its objectives the identification of Cygnus A as an X-ray source, and the location of other X-ray sources in the region of Cygnus. The description covers the experiment plan, the hardware design, testing and calibration, the flight proper, and the preliminary data analysis. C.L.W.

N67-22792# Aeronautical Research Council (Gt. Brit.).
CALIBRATION METHODS FOR THE ACCURATE ASSESSMENT OF THE STATIC AND DYNAMIC PERFORMANCE OF SOME FLIGHT TESTS INSTRUMENTS
I. McLaren Sep. 1963 47 p refs Supersedes RAE-TN-AERO-2914; ARC-25592; see X64-13173
(ARC-CP-760-RAE-TN-AERO-2914; ARC-25592) CFSTI: HC $3.00/MF $0.65

Methods for measuring the static and dynamic performance of some flight test instruments are reviewed with special reference to calibrating equipment such as turntables, pendulums, shaking tables and special exciters. The principles of frequency response tests are discussed in association with the theoretical characteristics of various, nominally, second order systems which are modified either by the method of testing or by the inherent, practical difficulties of instrument design. Discussion is largely confined to the testing of sensing elements such as linear and angular accelerometers, rate gyroscopes, windvanes, and ancillary devices such as filters and galvanometers. A brief résumé is also given of the characteristics and idiosyncrasies of measuring systems in general use. Author

N67-22874*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A METHOD TO CORRECT THE CALIBRATION SHIFT OBSERVED IN A NIMBUS MEDIUM RESOLUTION INFRARED RADIOMETER ON THE NASA CONVAIR 990 AIRCRAFT
Barbara Sparkman Feb. 1967 41 p refs
(NASA-TM-X-55741; X-622-67-37) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A Nimbus Medium Resolution Infrared Radiometer (MRIR) flown on the NASA Convair 990 aircraft experienced a shift in calibration of its three infrared channels such that measurements became increasingly too low with increasing aircraft altitude, to the plane's maximum altitude of 42,000 ft. Using the Radiometers built-in check-of-calibration cavity (the housing, with temperature monitored separately by means of an imbedded thermistor), and assuming that the entire calibration is shifted by the increment of effective radiance indicated by the check-of-calibration, the degraded measurements can be corrected. Tests were made of the validity of this approach, and good agreement was obtained with theoretically computed temperatures after accounting for radiative transfer through the atmosphere. Author

N67-22936# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
AIRBORNE AND MISSILE BORNE CAMERAS DEVELOPED BY WEAPONS RESEARCH ESTABLISHMENT
F. Spencer Sep. 1966 46 p refs
(WRE-ISD-TN-78) CFSTI: HC $3.00/MF $0.65

Described are eight cameras which are designed for use as instrumentation cameras, i.e. the only objective is to take measurements from the film. The designs do not permit cinematographical projection of the film; stressed in the designs are increased frame size, reduced camera size, simplicity, and ruggedness. All the cameras are fitted with a register glass carrying some form of graticule, usually a pair of lines at right angles ruled right across the format. Data recording cards are provided with each camera. On each camera is some reference from which the direction of the camera axes may be defined. Except for one single shot camera, all have some provision for recording time. Several of the cameras use variations of two ultra wide angle lenses which have a field of view of just over 180°. Conventional lenses have also been fitted to some of the cameras. The cameras are designated WRETAR, WRETAR-B, WRECISS Mk.2, WREROC Mk.1, WREROC Mk.2, WREMARC-B, WREMARC-C, and WRESLAC. K.W.

N67-22975# Japan Atomic Energy Research Inst., Ibaraki.
A QUICK RESPONSE IONIZATION SURVEY-METER
Teruichi Tomura Jan. 1966 16 p refs Submitted for publication Revised
(NSJ-TR-3, Rev.) CFSTI: HC $3.00/MF $0.65

A quick response ionization survey-meter and some problems concerned with α-contamination are described. To measure small currents a high resistor and a dc amplifier are used. The time response of such a device has usually been improved by the negative feedback, but there is a limitation because of the capacity parallel to the high resistor. This capacity can be reduced by means of a new device, and the use of a high gain dc amplifier at the same time makes the response extremely quick. By this method, the time constant less than 0.5 sec was accomplished with a resistor of 10^{13} ohms, and 1 mr/h of full scale was realized with an air ionization chamber of the volume about 400 cc. The response of the device is actually limited by the statistical fluctuations of the ionization current due to the measuring γ-radiations. The theoretical considerations about these problems are discussed and confirmed by the measurement using an experimental instrument.
Author

N67-22980# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
ROTATING CRYSTAL SPECTROMETERS WITH AND WITHOUT AN AUXILIARY DEVICE FOR SUPPRESSION OF UNWANTED REFLEXIONS
Georg Quittner and Edgar Legler [1966] 24 p refs Submitted for publication Sponsored in Part by U.S. Gov't.
(SGAE-PH-48/1966) CFSTI: HC$3.00/MF$0.65

Three types of device for suppression of unwanted reflections are compared. The phased Fermi chopper has important advantages over the other two. The potential gains to be expected from the use of such a device are increase in intensity, reduction in background, and more freedom in the choice of the primary energy and of the reflecting plane. The actual gain depends on several factors, including both external conditions and the fulfillment of certain design requirements. It is pointed out that these factors should be weighed against the relatively high costs that must be put into development and construction of a device of this kind.
Author

N67-22989# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE APPLICATION OF SOLID STATE AMPLIFYING RADIATION DETECTORS IN HEALTH PHYSICS
A. R. Jones Jan. 1967 20 p refs
(AECL-2637) Available From Atomic Energy of Canada, Ltd., Chalk River: $0.50

To assess amplifying radiation detectors for use in health physics, measurements were made on five samples. The properties measured were: dependence of noise on applied voltage, dependence of gain on applied voltage, dependence of sensitivity to gamma rays on energy, dependence of sensitivity to gamma rays on voltage, and dependence of sensitivity to gamma rays on temperature. It is suggested that the detectors would be suitable for measuring exposures, or doses, and their rates over a wide range of energies (0.03–1.25 MeV) and over a wide range of exposure rates (background up to $\approx$1000 roentgens/hour).
Author

N67-22993# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE DESIGN AND USES OF A MINIATURE RECORDING γ-RAY DOSIMETER
A. R. Jones Jul. 1966 21 p
(AECL-2629) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

The report describes the evolution of design of the dosimeter, its performance, and application. The dosimeter is comprised of: a regulated high voltage supply, a low sensitivity GM counter, and electrostatic scaler, a miniature wrist-watch counter, and a means for controlling power taken by the high voltage supply and checking the state of the battery. It measures doses to the wearer in the range 4 mrad to 432 rad at rates from 1 mrad/h to 100 rad/h. The battery lasts for at least three months.
Author

N67-23021 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
A MULTIPLEX DEVICE BUILT FOR OBTAINING SEVERAL MEASURING DATA VIA ONE SINGLE COAXIAL CABLE [EINE REALISIERTE MULTIPLEX–MESSEINRICHTUN ZUR ERFASSUNG MEHRERER MESSDATEN UEBER EIN EINZIGES KOAXIALKABEL]
W. Koch Brussels, EURATOM, Jan. 1967 42 p refs In GERMAN
(EUR-3256.d) CFSTI: $3.00

The multiplex measuring system allows the transmission of different slowly varying measurement values form the point to be measured to the indication point over a coaxial cable. The problem of the registration of measuring values for the screened two-core cable arose out of bursting and fealing difficulties when using several cables.
Author

N67-23034# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Neutronenphysik.
A HIGH DISSIPATION SPECTROMETER FOR VERY SLOW NEUTRONS FOR THE APPLICATION TO THE COLD SOURCE OF A MAXIMUM FLUX REACTOR [EIN HOCHAU-FLOESENDES SPEKTROMETER FUER SEHR LANGSAME NEUTRONEN ZUR VERWENDUNG AN DER KALTEN QUELLE EINES HOECHSTFLUSSREAKTORS]
R. Scherm Aug. 1965 26 p refs In GERMAN
(JUL-295-NP) CFSTI: HC$3.00/MF$0.65

Evaluated was the design of a high resolution spectrometer that utilizes a rotating slit-disk chopper and a neutron flux guide to obtain very slow neutron scattering impulses from the cold source of a nuclear reactor. The instrument is applicable for neutrons of 4 to 25°A and has an energy resolution of 0.4 to 5%. Also discussed was a rotating crystal spectrometer and a rotating axis spectrometer, and it was shown that crystal spectrometers have a certain limitation because their incidence energy and resolution are coupled with each other.
Transl. by G.G.

N67-23035# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorbauelemente.
A DISTRIBUTION SYSTEM FOR A MULTICHANNEL HIGH FREQUENCY IMPULSE ANALYZER [EIN AUSGABESYSTEM FUER EINEN VIELKANAL-IMPULSHOEHEN-ANALYSATOR]
G. Riepe and L. Jung May 1965 23 p refs In GERMAN
(JUL-270-RB) CFSTI: HC$3.00/MF$0.65

Described is an electronic console that utilizes punched tapes to obtain a quantitative distribution of spectral impulses received from multiple channel spectrographs. The digital readout for the programmed channel measurements uses Gause distribution to produce the peak positions and the integral beyond peak for half values. An example calculation for the photo-peaks of Cs^{137}, measured by thallium doped sodium iodide crystal, as a function of multiplier voltage is included.
Transl. by G.G.

N67-23041# New York Univ., N. Y. Research Div.
PRECIPATION WATER CONTENT METER Final Report, Feb. 5, 1962–Aug. 4, 1963
Alan M. Nathan and Leon Bennat Jun. 1966 53 p refs
(Grants DA-Sig-36-039-62-G20; DA-Sig-36-039-63-G63; ARPA Order 265-62)
(FR-1004; AD-644122) CFSTI: HC$3.00/MF$0.65

A project to develop a means of measuring only the precipitation water content from an aircraft flying through rain resulted in a new type of meteorological sensor. The instrument is basically an air gap capacitor which utilizes centrifugal force to drive all captured water droplets out between the capacitor plates. Because of the high dielectric constant of water, large changes in capacity are observed as a function of water input rate. The sensor has a response time of less than one second and is self-clearing. In the contemplated airborne application, where only

large drops were desired (no cloud droplets), aerodynamic sorting is used to shunt aside all smaller drops from the intake. The aerodynamic filtering would be accomplished by means of a specially shaped wing tip-tank which would house the sensor. The tip-tank shape was empirically arrived at after much testing in a specialized wind-rain tunnel constructed for the purpose. Collection efficiency and prototype sensor calibration data are presented. The basic sensor may also have applications to cloud liquid water content measurement problems and to the measurement of instantaneous rainfall rate. Author (TAB)

N67-23052*# Control Data Corp., Minneapolis, Minn. Research Div.
FEASIBILITY STUDY FOR A SCANNING CELESTIAL ATTITUDE DETERMINATION SYSTEM (SCADS) FOR THREE AXIS ATTITUDE DETERMINATION AT A COMMAND AND DATA ACQUISITION (CDA) STATION Final Report
C. B. Grosch, R. W. Peterson, R. C. Borden, D. F. Nickel, A. J. Mooers et al 22 Sep. 1965 458 p refs
(Contract NAS5-9577)
(NASA-CR-83523; RD-2001) CFSTI: HC $3.00/MF $0.65 CSCL 14C

The attitude determination concept relies upon an instrument which consists of a scanning wide-angle camera with a slit positioned on its focal surface. Applications of such a concept for the Nimbus and Tiros spacecraft configurations are emphasized. The effort during the study was devoted to the areas of optical, electrical, and mechanical design; optimum instrument design in view of the stellar background and detection limits of photodetectors; error analysis by means of computer simulation; and star identification. Recommended designs are given. The design for the Tiros instrument is somewhat simpler than that of the Nimbus instrument. Author

N67-23086# Royal Aircraft Establishment, Farnborough (England).
NIGHT PHOTOGRAPHY WITH THE LATEST U.S. ELECTRONIC FLASH UNITS
R. Watts Jul. 1966 22 p
(RAE-TR-66227) CFSTI: HC $3.00/MF $0.65

Flight trials to assess the effectiveness of modern electronic flash systems, when used with an available camera and film, have been completed. Three different units, with different flash powers, were tried. The areas of ground illuminated, and the heights from which photography was possible were measured for each unit. The evenness of the illumination and the effect of back-glare from atmospheric haze were examined. An into-dusk flight confirmed that there should be no difficulty in using electronic flash to boost fading daylight after sunset. Author

N67-23096 European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
A MASS-SPECTRUM-DIGITIZER FOR THE ATLAS TYPE CH-4 MASS-SPECTROMETER
M. J. Mol Dec. 1966 52 p
(EUR-3176.e)

To reduce the time required for the interpretation of mass spectra, a mass spectrum digitizer was constructed, that automatically prints the spectral information in digital form. The characteristics of the spectrometer output signals and the design principle based on these signals are described. The results of tests performed under different operating conditions of the spectrometer are given. Author

N67-23098# Weapons Research Establishment, Salisbury (Australia).
A METER TO MEASURE FREQUENCIES BELOW 1 kc/s
J. Keen Sep. 1966 15 p ref
(WRE-ISD-73) CFSTI: HC $3.00/MF $0.65

This note describes a portable meter to measure frequencies in the range 0.1 c/s to 1 kc/s. The circuit as designed is suitable for use with electromechanical transducers whose output can be a frequency output within this range, such as flowmeters, tachometers, or anemometers. The circuit is described, its errors analyzed and it is shown that the instrument can be stable to 0.2% of full scale deflection. The design allows the instrument to operate over a wide range of battery voltages and ambient temperatures. Author

N67-23127# Army Personnel Research Office, Washington, D. C.
EXPLORATORY STUDY IN INTERPRETATION OF VERTICAL AND HIGH OBLIQUE PHOTOGRAPHS Technical Research Note 174
Abraham H. Birnbaum Jun. 1966 43 p refs
(AD-643242) CFSTI: HC $3.00/MF $0.65

The study set out to determine the relative utility of vertical and oblique views and to define the conditions under which each is more effective. Interpreter performance in extracting information from vertical and oblique views was compared. Sixty-four experienced interpreters, divided into two groups of 32 each, interpreted vertical and oblique views of a common area. Two sets of photographs were used, one of an airfield, the other of a bridge. Performance comparisons for the airfield photos were for common areas constituting the foreground, background, and total area. For the bridge, only the total overlapping area was used. Comparisons were made separately for detection and identification, counting of objects, and mensuration. Vertical photos were found to be better for identification of objects with major dimensions in the horizontal plane, oblique photos for objects with major dimensions in the vertical plane. Mensuration was much easier on vertical photos than on oblique photos. In oblique viewing, completeness of interpretation, but not accuracy, was affected by the portion of the photo being interpreted. For the foreground, completeness was 28.5%, for the background 8.8%. Author (TAB)

N67-23149# Autonetics, Anaheim, Calif.
ELECTRO-OPTIC PROJECTOR STUDY Final Report, 9 Apr. 1965-9 Jun. 1966
E. A. Reitz, R. S. Stites, and J. D. Pace Dec. 1966 139 p refs
(Contract AF 30(602)-3730)
(C6-1253/34; RADC-TR-66-394; AD-646232) CFSTI: HC $3.00/MF $0.65

The report describes research and development tasks undertaken in the development of a Pockels Effect electro-optic light valve. Two reflex configurations of the light valve are described which provide coaxial light and electron optics, and allow thermal control of the crystal. Immersion and thin lens electron optics are used in different configurations. The electro-optic crystal utilized was KD2PO4 and when operated in a reflex mode provides full modulation with approximately 1700 volts. With analysis and design complete, breadboard light valves and a test assembly were prepared. Developmental problems prevented full evaluation of the designs prepared and only limited test data were taken. TAB

N67-23168# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
A SYSTEMATIC STUDY OF STRUCTURED MICROPULSATIONS
J. F. Kenney and H. B. Knaflich Nov. 1966 32 p refs
(D1-82-0576; AD-646234) CFSTI: HC $3.00/MF $0.65

A pair of three-component micropulsation detectors are in operation near Seattle, Washington to investigate the cause and behavior of pc 1 micropulsations. The mid-frequency and bandwidth of pearls show very strong diurnal variations, but any seasonal changes which may exist are smaller than changes due to other factors, such as compression of the magnetosphere during disturbed times. Seasonal variations in the diurnal occurrence of

pearls at middle latitudes are, however, large. The observations imply the existence of a pearl oval that responds to changes in the magnetosphere with solar activity. The majority of the pearls showed the characteristics of wave propagation through a dispersive magnetosphere and subsequent ducting through a nondispersive ionosphere. A particle-wave interaction is consistent with the experimental data if the basic interaction is due to a resonance between the wave and a Doppler-shifted ion gyrofrequency of extra-thermal protons flowing through the background dispersive medium. Grouping of the protons into bunches is not consistent with most of the events which have been analyzed. Author (TAB)

N67-23181# Babcock and Wilcox Co., Alliance, Ohio. Research Center.

HIGH TEMPERATURE STRAIN GAGES FOR USE IN SODIUM ENVIRONMENTS

V. Rastogi 20 Dec. 1966 30 p refs

(Contract AT (11-1)-1280)

(BAW-1280-41; RR-5138) CFSTI: HC$3.00/MF$0.65

The selection of and techniques for using high temperature strain gages in equipment like the B & W prototype sodium-heated steam generator are discussed. NSA

N67-23213# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

APPARATUS FOR MEASURING BUBBLE CHAMBER PICTURES [APPAREIL DE MESURE DE CLICHES DE CHAMBRE A BULLES]

Roger Miet and Christian Calmels Oct. 1966 13 p In FRENCH

(CEA-R-3046) CFSTI: HC$3.00/MF$0.65

A description is given of a new type of measuring projector for bubble chamber pictures named BICHE, especially adapted to chambers with 4 cameras and 50 mm film (50×150 mm pictures). This apparatus is of a conventional type, with fixed film and movable optics (objectives, arrow and illumination). It has the following advantages: The projection of each picture occurs simultaneously on two screens with two different magnifications, 6 and 25. The measurement is made on magnification 25, allowing high precision. On the magnification 6 screen, the whole picture is seen for control. The loading and unloading of the spools is very simple; it is made outside the apparatus. The total bulk of the projector is rather small. Author (NSA)

N67-23215# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik.

ELECTRONIC SAFETY DEVICES WITH μA READINGS FOR SEMICONDUCTOR DETECTORS [ELEKTRONISCHE SICHERUNG MIT μA ANZEIGE FUER HALBELEITERDETEKTOREN]

Joachim Kind Mar. 1966 15 p In GERMAN

(KFK-426) CFSTI: HC $3.00/MF $0.65

The operation of semiconductor detectors requires a slow and steady rise of the current up to the final value as well as continuous control of the set current in the operating range, since exceeding the permissible current, which in many cases is only a few microamperes, may destroy the expensive semiconductor detectors. An electronic protective device is described. This equipment allows the separate simultaneous connection up to four semiconductor detectors. A time constant takes care of a slow and steady rise of the set currents to the ultimate value. Four separately adjustable electronic fuses protect the semiconductor detectors. The supply currents can be read from installed instruments. Author (NSA)

N67-23217# California Univ., Berkeley. Lawrence Radiation Lab.

LITHIUM-DRIFTED SILICON DETECTOR USED AS A PULSE DOSIMETER

Mudundi R. Raju, Edward J. Lampo, Stanley B. Curtis, Johnie M. Sperinde, and Chaim Richman 27 Sep. 1966 10 p refs Presented at the 13th Ann. Nucl. Sci. Symp., Boston

(Contract W-7405-ENG-48)

(UCRL-16924; CONF-661020-15) CFSTI: HC$3.00/MF$0.65

A lithium-drifted silicon detector used as a pulse radiation dosimeter is described. It is used to measure the depth-dose distribution of pion beams in water. The fractional dose due to energy depositions above a particular energy in the detector can also be measured. Such measurements yield information on the distribution of ionization density. Preliminary results of the pion-beam dosimetry using this pulse dosimeter are given. Author (NSA)

N67-23237# Rensselaer Polytechnic Inst., Troy, N. Y.

CALIBRATION OF A LARGE PROTON RECOIL DETECTOR FOR FAST NEUTRON SPECTRA MEASUREMENTS

R. H. Augustson, E. R. Gaerttner, E. R. Gozani, T. Kaushal, B. K. Malaviya et al 1966 6 p refs Presented to the 1966 Ann. Meeting of the Am. Nucl. Soc. at Pittsburgh, Pa., 30 Oct.–4 Nov. 1966

(Contract AT(30-3)-328)

(CONF-661001-4) CFSTI: HC$3.00/MF$0.65

The efficiency of a large proton recoil detector as a function of neutron energy was determined by two independent methods: one based on the photonuclear spectrum of the deuteron and the other involving a smaller calibrated scintillation detector. A comparison of the efficiency over the energy range from 0.7 to 10 MeV shows good agreement. NSA

N67-23325*# Avco Corp., Wilmington, Mass. Research and Technology Labs.

FEASIBILITY STUDY OF A METEOROID COMPOSITION ANALYZER SPECTROGRAPHIC SYSTEM Final Report

3 Nov. 1966 154 p refs

(Contract NAS9-5267)

(NASA-CR-65607; AVSSD-0219-66-RR) CFSTI: HC $3.00/MF $0.65 CSCL 20F

It is shown that spectrographic determination of the composition of micrometeoroids is feasible through analysis of emission spectra resulting from heating of the particle as it passes through a captive inert atmosphere. Spectra obtained from ablation of actual meteoritic materials during laboratory simulation experiments are shown. Ballistics range experiments were made using a light gas gun to launch simulated and actual meteoritic particles into captive atmospheres of xenon and argon. A miniature spectrographic system was fabricated to provide maximum optical speed to obtain spectra from these ballistics range tests. Feasibility was demonstrated by analysis of these spectral data. Analysis included comparison with other emission spectra obtained by carbon arc excitation of samples of the same meteorites. Correlation was excellent. Extension of this concept to a spaceborne experiment is discussed. Author

N67-23376# Commissariat a l'Energie Atomique, Saclay (France).

THE CHANGERS OF TIME CONSTANT IN THE FILTERS OF DC LOGARITHMIC PERIODMETER–RESULTS AND POSSIBILITIES (1964) [VARIATION DES CONSTANTES DE TEMPS DE FILTRAGE DANS LES PERIODEMETRES LOGARITHMIQUES–RESULTATS ET POSSIBILITES (1964)]

Claude Faraguet and Robert Quenee Jan. 1966 41 p refs In FRENCH

(CEA-R-2940; PB-169534) CFSTI: HC$3.00/MF$0.65

For application to nuclear reactors, a logarithmic periodmeter for the ionization chamber is described in mathematical terms. Two prototype periodmeters were constructed, the operating principles of which are shown schematically. Technical details are also given on the circuitry and filter system used. Transl. by R.U.

N67-23395# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
HOT-WIRE ANEMOMETERS AT CONSTANT TEMPERATURE [ANEMOMETRES A FIL CHAUD A TEMPERATURE CONSTANTE]
Raymond Galinaro and Pierre Gougat Nov. 1966 24 p refs In FRENCH
(Rept.-66-11; Publ.-283) CFSTI: HC $3.00/MF $0.65

Hot-wire anemometers were constructed for measurement of mean velocity, fluctuations, and correlation coefficients of turbulent flows. A constant resistance was obtained by mounting the wire on one arm of a Wheatstone bridge maintained in equilibrium by an electronic amplifier. The elementary theory of a hot wire is explained by consideration of turbulent flows at subsonic velocity. Experimental results show that the chosen linear system has an advantage and that the apparatus provides an output signal that is always proportional to velocity, whatever the characteristics of the wire or resistance chosen. ESRO

N67-23462# Hewlett-Packard Co., Palo Alto, Calif. Frequency and Time Div.
USING A REVERSIBLE COUNTER
[1966] 41 p refs *Its* Appl. Note 85
CFSTI: HC $3.00/MF $0.65

A broad coverage of the measurement and control situations for which a reversible (or bidirectional) counter is eminently suited is presented. The decades in such a counter have the ability to totalize in a negative as well as a positive direction, and to count through zero in both directions. As a result, the counter finds great use where a need to subtract is required; where two frequencies or rates are to be compared; where a variable is to be compared against a reference; or where absolute position, positive or negative, is to be indicated. The reversible counter and its many features are described. The input signal requirements and limitations are then detailed, followed by a discussion of those transducers that may be used to measure a physical property and convert this measurement into an electrical signal suitable for feeding into the reversible counter. Next, there is brief mention of the output signals provided by the counter, and of the devices that may be coupled to the output for recording, scanning, or transmission of data to an indicating instrument or a complete data acquisition system. Finally, there is a description of a few typical applications in which this versatile counter may be used; the intention is not only to describe what has been done before, but mainly to stimulate the reader's imagination to seek further applications for the counter. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-22070*# Republic Aviation Corp., Farmingdale, N. Y.
DEVELOPMENT OF NONDESTRUCTIVE, AUTOMATIC TECHNIQUE FOR MONITORING AND RECORDING OF FATIGUE CRACK GROWTH Final Report
Frank J. Hoppe and Nelson Inman 9 Feb. 1967 54 p
(Contract NAS1-5044)
(NASA-CR-66320; FHR-3294-2) CFSTI: HC $3.00/MF $0.65
CSCL 13H

The development of a single tracking probe producing a surface wave for the detection of a fatigue crack is described. A water coupled angle-transducer system was developed and traversed by a servo to follow the leading edge of a slot or a crack. Basic information on construction of the mechanical and electrical systems is given. Details are also given on operational tuning procedures. Author

N67-22145*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COATINGS QUALIFICATION
Alfred Hobbs and Ben Seidenberg *In its* Radiometry Res. Mar. 1967 7 p (See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65

Research and development and degradation equipment procurement are discussed in a program in direct support of passive and thermal control coatings development. It is reported that an analytical chart was prepared listing coatings used on satellites, and that a methyl–silicone white paint was synthesized. A promising black metallic–oxide coating for vacuum chamber shrouds is being developed, along with large area thermocouples for paint substrates. C.T.C.

N67-22288# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
METALLURGY Quarterly Progress Report, Jul. 1–Sep. 30, 1966
H. Gordon Poole 30 Sep. 1966 44 p refs
(Contract AT(11-1)-599)
(USBM-RC-1264; QPR-32) CFSTI: HC $3.00/MF $0.65

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N67-22289# Bureau of Mines, Albany, Oreg.
HIGH MELTING POINT CARBIDES
R. A. Beall and R. P. Adams *In its* Met. 30 Sep. 1966 p 1–11 refs (See N67-22288 11-15) CFSTI: HC $3.00/MF $0.65

The objectives of this program are to develop casting methods and equipment to produce required shapes of the high-melting-point metal–carbon compositions and, second, to evaluate these materials for their physical properties. Author

N67-22290# Bureau of Mines, Albany, Oreg.
THORIUM ALLOY SYSTEMS
Hal J. Kelly, Gene Asai, Stephen O'Hare, and Paul Francoeur *In its* Met. 30 Sep. 1966 p 12–15 ref (See N67-22288 11-15) CFSTI: HC $3.00/MF $0.65

The improvement of the physical properties of thorium–thoria cermet is the objective of this project. A processing schedule to obtain optimum density by varying compacting pressure, sintering time, and sintering temperature is being studied as well as the bond between the metal matrix and the oxide phase. Author

N67-22291# Bureau of Mines, Albany, Oreg.
INVESTIGATION OF THE SYSTEM UC-UN-UO

Hal J. Kelly, Jack L. Henry, Danton L. Paulson, and Robert Blickensderfer *In its* Met. 30 Sep. 1966 p 16–23 (See N67-22288 11-15) CFSTI: HC $3.00/MF $0.65

The objective of this program is the investigation of the monocarbide–mononitride–monoxide region of the quaternary system U-C-O-N in connection with its usefulness in the production of high temperature nuclear reactor fuels. Of particular interest are the subliquidous phase relationships within the system and the evaluation of such properties as thermal stability, thermal conductivity, uranium density, and hot-hardness. Author

N67-22292# Bureau of Mines, Albany, Oreg.
W–Re–Mo ALLOY DEVELOPMENT
Hal J. Kelly, Gene Asai, Ronald Lowery, and James Sarvis *In its* Met. 30 Sep. 1966 p 24–31 (See N67-22288 11-15) CFSTI: HC $3.00/MF $0.65

The primary objectives of this project are (1) to prepare tungsten alloy sleeves which can be subsequently extruded and drawn into engineering quality tubing at other laboratories, and (2) to compare the mechanical properties for W–Re alloy sheet prepared from powder metallurgy and arc-melted billets. Forty-five kilograms of rhenium are available for use, but it is not known what additional amounts of rhenium will be needed to attain the objectives stated above. Author

N67-22388# Los Alamos Scientific Lab., N. Mex.
TEE DRAWING FOR TUBULAR VACUUM SYSTEMS
Hermann M. Ruess, James D. Newkirk, and Norman G. Wilson 28 Nov. 1966 34 p
(Contract W-7405-ENG-36)
(LA-3517) CFSTI: HC $3.00/MF $0.65

Improved welded tee connections are made by drawing a die of circular cross section through an elliptical cutout in the wall of the main tube to form a smooth tee transition, and then butt-welding an extension tube to this opening. Fabrication procedures, tooling, and equipment have been developed for stainless steel tubing of from 1 to 6 in. OD with 0.065- and 0.025-inch wall thickness. The process has been successfully applied to copper, Inconel, aluminum, and type 304, 316, and 321 stainless steels. Author (NSA)

N67-22412# Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE LIMITING LOAD WHEN CONDUCTING ACCELERATED TESTS
L. Ya. Peshes and M. D. Stepanova *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 136–143 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

The principle of determination of the forced condition (limiting load) is proposed for conducting tests for reliability in the shortest times based on the general laws of expenditure of resources of the capacity to do work using products of various types. The algorithm for finding the limiting load is presented. Author

N67-22461# British Hydromechanics Research Association, Cranfield (England).
A BIBLIOGRAPHY ON CONTAMINATION AND FILTRATION, WITH PARTICULAR REFERENCE TO OIL HYDRAULIC SYSTEMS
G. M. Barratt and T. E. Brock, comp. Apr. 1966 63 p refs
(BIB-19) CFSTI: HC $3.00/MF $0.65

This bibliography contains 178 references arranged in chronological order, dealing with contamination and filtration in oil hydraulic systems. Some items dealing with micronic filtration of lubricants, coolants and fuels have been included but emphasis has been placed on problems connected with oil hydraulic fluids and components. Some abstracts are given. Author

N67-22539# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW METHOD OF PRODUCTION OF CLAD PLATE ROLLED PRODUCTS FOR PRESSURE VESSELS
V. A. Lutsyuk-Khudin 20 Jul. 1966 54 p refs Transl. into ENGLISH of the publ. "Novyy Sposob Proizvodstva Tolstolistovogo Dvukhsloynogo Prokata Dlya Sosudov Vysokogo Davleniya" Kiev, 1965 p 1–81
(FTD-MT-65-468; TT-67-60484; AD-645787) CFSTI: HC $3.00/MF $0.65

Contents: Manufacture of clad steels by method of lining with subsequent rolling; Manufacture of clad steels by pack method; Manufacture of plate rolled stock with application of electroslag welding; Technology of electroslag welding of clad billets; Dimensions of clad billets under rolling; Heating under rolling and rolling of clad billets; Addition materials for welding of clad billets and conditions of heat treatment; Production of thick-walled welded pressure vessels from clad steels; Technology of welding clad vessels; Concerning the question on rejection of high-temperature treatment of welded vessels and improvement of quality of metal of durable casing. TAB

N67-22566# Naval Ordnance Lab., White Oak, Md.
AN OMNIDIRECTIONAL PRESSURE GAGE FOR MEASUREMENT OF WEAK BLAST WAVES
John L. Lankford 29 Aug. 1966 58 p refs
(NOLTR-65-172; Ballistic Res. Rept.-150; AD-645694) CFSTI: HC $3.00/MF $0.65

An aerodynamic sensor was developed which is applicable to the measurement of the static pressure behind weak blast waves. The sensor is a ventilated sphere suitable for use with various types of electronic sensing units. A method used for prediction of response characteristics, ventilation coefficients, and sizing parameters gave good preliminary results in the range of 3 to 10 psi overpressures. Preliminary test results indicate a considerable increase in omnidirectional capability over previous gage types for this application. The preliminary program was limited to design of an experimental configuration and evaluation of concept feasibility. Author (TAB)

N67-22657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMPROVEMENT OF FORGING PRODUCTION: GENERALIZATION OF EXPERIENCE OF URAL PLANTS
O. A. Ganago, V. A. Shalekhova, and I. M. Balyasnogo 13 Jul. 1966 200 p refs Transl. into ENGLISH of the book "Sovershenstvovaniye Kuznechno-Shtampovochnogo Proizvodstva: Obobshcheniye Opyta Ural'skikh Zavodov" Moscow, Mashoiz., 1963 p 1–216
(FTD-MT-65-54; TT-67-60478; AD-645774) CFSTI: HC $3.00/MF $0.65

The book concerns the improvement of the organization of production and planning in forging workshops, the improvement of the technology of hot and cold forging, smith forging, methods of heating, and also mechanization and automation of the processes of forging and stamping. TAB

N67-22612# Rome Air Development Center, Griffiss AFB, N. Y.
RELIABILITY PREDICTION—TODAY AND TOMORROW
Anthony J. Feduccia Jan. 1967 33 p refs Presented at the 1966 Spring Seminar at IEEE Reliability Group, Boston, 14 Feb. 1966
(RADC-SP-66-8; AD-645743) CFSTI: HC $3.00/MF $0.65

Reliability prediction techniques are usually divided into two categories: (1) Feasibility (or ballpark) prediction procedures and, (2) Design (or stress analysis) prediction procedures. This report briefly describes existing techniques in each category and outlines their capabilities, shortcommings and limitations. Suggestions for

developing new prediction techniques and for expanding present methods are also presented. Author (TAB)

N67-22787# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF HUMIDITY ON SOLID LUBRICANT FILMS
Edna Kay Mar. 1965 19 p refs
(RAE-TR-65047) CFSTI: HC $3.00/MF $0.65

The friction of thin rubbed films of graphite, molybdenum disulphide, tungsten disulphide and metal-free phthalocyanine on metal substrates increased markedly with the relative humidity of the surrounding atmosphere. Film endurance is also impaired, but the addition of 10% graphite of MoS_2 produces a marked improvement in performance over that obtained with MoS_2 alone. Although the friction of MoS_2 sliding on itself increases slightly with humidity, the nature of the metallic substrate is a major factor in thin film performance at high humidity. Author

N67-22842*# Aerojet-General Nucleonics, San Ramon, Calif.
AEROJET-GENERAL NUCLEONICS MERCURY CORROSION LOOP PUMP
J. H. Ralphs and E. F. McDaniel 17 Feb. 1964 33 p
(NASA-CR-72201; TM-390-64-8-204) CFSTI: HC $3.00/MF $0.65 CSCL 13K

Six pumps were fabricated for the Mercury Corrosion Loop Testing Program. The wetted parts of the various pumps were made of different materials: Type 316 stainless steel in the prototype, Haynes Alloy 25 in the next four pumps, and 9% chromium–1% molybdenum (9Cr–1Mo) alloy steel in the sixth. The stainless steel pump was tested in a non-boiling mercury pump-testing loop to establish the feasibility of the design and to determine whether any changes were required before use of the pumps in the boiling mercury loops. The Haynes 25 pumps were tested in the pump test loop and also were operated in the mercury corrosion loops. Through testing and loop operation, a type of pump was evolved which was capable of supplying 1200 lb/hr of mercury at an output pressure of 450 psig. The principal deficiency found in the pumps was the short lifetime of the mechanical seal separating the inert gas space above the mercury from the atmosphere. The service life of these seals proved to be about 200 operating hours. Author

N67-22879* Aerojet-General Corp., Azusa, Calif.
CUP-SEAL INTERFACE CHARACTERISTICS
A. H. Kreeger and O. C. Anson 22 Apr. 1963 53 p refs
(NASA-CR-72222; TM-355-63-5-102) CFSTI: $3.00 CSCL 13K

Tests were conducted to investigate the stability of liquid-liquid and liquid-vapor interfaces in a test rig designed to simulate a proposed dynamic seal for the SNAP-8 turbine alternator assembly. The fluids tested were water, mercury, and glycerine. Visual examination, pressure measurements, and power loss measurements were conducted with a 3.510 inch diameter stationary disk in a rotating fluid field contained by a 3.815 inch inside diameter rotating housing. Rotational speeds were limited to 2000–5000 rpm since the housing was fabricated from lucite. The interface radius was varied from 1.75 inch to 1 inch for all measurements. The photographs show that the interface was very wavy, but was not significantly affected by a change in rotational speed. Viscosity and interface radius (interface level) were evidently the only influencing variables. Power loss measurements showed that losses of 0.2 and 0.3 hp were realized at 12,000 rpm for mercury and glycerine, respectively. Author

N67-22888* Aerojet-General Corp., Azusa, Calif.
ELECTROMAGNETIC PUMPS USED IN SNAP-8 TEST SUPPORT EQUIPMENT
S. L. Bradley 2 Mar. 1966 11 p
(NASA-CR-72214; TM-4936-66-393) CFSTI: HC $3.00/MF $0.65 CSCL 13K

Alternating current electromagnetic pumps used in SNAP-8 tests are discussed. The operating characteristics, problems, and failures encountered and action taken and recommended to improve performance and reduce failures are considered. Author

N67-22891*# Aerojet-General Corp., Azusa, Calif.
PRELIMINARY EXAMINATION OF PROTOTYPE REFRACTORY BIMETALLIC TUBING FROM NUCLEAR METALS, INCORPORATED
C. A. Landusky 27 Jan. 1964 11 p
(NASA-CR-72202; TM-390-64-4-199) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Prototype tubing of Cb/316SS and Cb–1Zr/316SS from Nuclear Metals, Incorporated were evaluated to determine the bond quality. The tests employed were metallographic and ultrasonic inspection before and after coiling to an eight-inch diameter. This tubing was produced by hot co-extrusion and cold reduction. The bond in the Cb/316SS tubing was perfect on the basis of the tests applied. The Cb–1Zr/316SS tubing had extensive unbonded areas in the as-received condition. After coiling, the entire outside diameter of this coil was unbonded. Author

N67-22892* Aerojet-General Corp., Azusa, Calif.
SNAP-8 MERCURY JET-CENTRIFUGAL PUMP HYDRAULIC DESIGN
C. L. Foss 13 Oct. 1965 32 p refs
(NASA-CR-72220; TM-4932-65-2-336) CFSTI: $3.00 CSCL 13K

The hydraulic design calculations of the mercury jet-centrifugal pump are covered. The pump is to be used in the SNAP-8 configuration. Author

N67-22894*# Aerojet-General Corp., Azusa, Calif.
MATERIALS EVALUATION OF TRANSITION JOINTS FOR TRANSFORMER REACTOR ASSEMBLY
F. H. Cassidy 11 May 1965 20 p refs
(NASA-CR-72195; TM-4923-65-4-301) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The chemical compatibility of tubular transition joints connecting aluminum and 304 SS when exposed to mix-4P3E polyphenyl ether was determined at 250°F for times up to 2500 hours. Several metallic coating materials, utilized to cover the copper portion of a multi-metal transition joint, were evaluated, as was a coextruded direct-bonded aluminum-304 SS joint. All of the materials tested appeared to be completely compatible with the mix-4P3E. However, the coatings were unsatisfactory due to either the coating technique or inherent properties of the coating. The coextruded, direct-bonded aluminum-304 SS joint appeared unaffected. The effects of the metals on the mix-4P3E were so slight that measured property changes can be attributed to experimental technique. Author

N67-23037# British Hydromechanics Research Association, Cranfield (England). Information Dept.
REFERENCES ON OR RELATED TO SCREW-TYPE ROTARY SHAFT SEALS
Mar. 1966 14 p refs
(BIB-22) CFSTI: HC $3.00/MF $0.65

A compilation of abstracts related to screw-type rotary shaft seals of interest to hydromechanics is presented. Areas covered include screw viscosity pumps, the sealing action of a viscous fluid, helical groove seals, high speed lubricating oil pumps, and screw seals in laminar and turbulent operation. C.T.C.

N67-23089 Reactor Centrum Nederland, The Hague.
JET PUMPS

J. T. Wilman Brussels, EURATOM, Dec. 1966 62 p refs
(Contract EURATOM-007-61-6 PNIN)
(EUR-3253.e)

A theoretical study of the behavior of jet pumps is made on the basis of a simplified model. Experiments carried out with the object of optimizing the performance of jet pumps are described. It is found that the theoretically predicted results are in good agreement with the experimental data for high performance jet pumps. Finally, it is shown how, for given conditions, absolute jet pump dimensions can be calculated. Author

N67-23090# Rubber Research Inst. TNO, Delft (Netherlands).
CONTINUATION OF SWELLING TESTS OF CABLE SLEEVES IN 4 TYPES OF OIL [VOORTGEZETTE ZWELPROEVEN MET MANTELS VAN EEN AANTAL KABELS IN 4 OLIESOORTEN]
H. Geldof 10 Nov. 1966 4 p In DUTCH
(TDCK-46585) CFSTI: HC $3.00/MF $0.65

Eight cable sleeve samples of PVC, neoprene, and hypalon were immersed for 24 weeks in diesel oil and measured at regular intervals. The resulting data for volume increase and hardness of the samples are presented in a table. Transl. by K.W.

N67-23169# Martin Co., Denver, Colo.
CENTER FOR HIGH ENERGY FORMING Quarterly Report of Technical Progress, Jan. 1967
Gaylen A. Thurston 1 Jan. 1967 17 p Prepared jointly with Denver Univ.
(Contract DA-19-066-AMC-266(X))
(CR-66-05/7; QR-6; AD-646196) CFSTI: HC $3.00/MF $0.65

The mousetrap type plane-wave generator has been completed. Initial shock tests have been conducted on 2024-T3 aluminum sheet, copper, 70-30 brass, iron, and maraging steel. Accuracy of acceleration measurements to determine strain-rates in an expanding aluminum ring using a streak camera is being checked by recording known motion of a non-radial slit cut in a rotating disk. The correlation between physical properties of metals used in explosive welding and the success of the weld is being investigated. Checkout is continuing on a computer program to calculate strains in a blank formed into a frictionless die. A ring cut in a chevron pattern has proved effective in controlling edge pull-in of explosively formed domes. The chevrons contract to form the ring and engage a weld bead on the rim of the blank to limit the amount of pull-in. Author (TAB)

N67-23183# Battelle Memorial Inst., Columbus, Ohio.
EXPLOSIVE WELDING DUPLEX ZIRCALOY-ALUMINUM TUBING Summary Report
S. W. Porembka, R. H. Wittman, and R. H. Carlson 26 Oct. 1966 46 p refs
(Contract W-7405-ENG-92)
(BMI-X-412) CFSTI: HC $3.00/MF $0.65

The explosive welding of Al liners in Zircaloy-4 tubing was achieved by both mandrel and external die approaches. The use of a low-detonation-velocity explosive provided improvement in the welding of mandrel assemblies because of the reduced problems with shock damage effects in the mandrel. Welding with mandrel assemblies was found to be dependent on the uniformity of assembly and explosive powder loading; factors which did not lend themselves to precise control. The external die welding approach in conjunction with the low-detonation-velocity explosive yielded highly successful results in a limited series of experiments which included a 3-ft-long duplex tube. Explosive welds obtained by the two methods showed that the mandrel approach resulted in a greater amount of intermediate phase at the weld interface for the conditions studied. The results of this study demonstrate that the external die method would be more adaptable to welding long duplex tube lengths. Author (NSA)

N67-23278*# Chrysler Corp., New Orleans, La.
COMPOUND PRESSURE AND VACUUM RELIEF VALVE, 2-INCH. LADWIG VALVE COMPANY PART NUMBER 3302-F, NASA DRAWING NUMBER 75M04406 PRV-3
5 Dec. 1966 42 p
(Contract NAS8-4016)
(NASA-CR-83550; TR-RE-CCSD-FO-1112-3) CFSTI: HC $3.00/MF $0.65 CSCL 13K

The results are presented on the receiving inspection, proof pressure, functional, low and high temperature, cycle, salt fog, and burst tests. The requirements of all tests are reported met with the following as exceptions. During the initial proof pressure test a leak was noted, which disappeared during initial functional test. The vacuum relief valve did not meet the requirements of the functional test, but maintained its characteristics. The pressure relief valve was damaged by the fog environment. N.E.N.

N67-23288*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONTRIBUTION OF DOWNSTREAM STATOR TO THE INTERACTION NOISE OF A SINGLE-STAGE AXIAL-FLOW COMPRESSOR
W. Latham Copeland, John L. Crigler, and Andrew C. Dibble, Jr. Washington, NASA, Apr. 1967 20 p refs
(NASA-TN-D-3892) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Some experimental results are presented of a noise study of a single-stage axial flow compressor tested in an anechoic chamber. A variable-speed electric motor was used to drive the compressor rotor through a range of rotor tip Mach numbers from 0.20 to 0.50. Provisions were made for testing separately the inlet guide vane–rotor combination, the rotor–stator combination, and the inlet guide vane–rotor–stator combination. The test setup included capability for increasing the spacing between the inlet guide vanes and the rotor. The data are presented in the form of noise radiation patterns and frequency spectra. These data show that the noise levels due to the interactions of rotor and downstream stator are appreciably less than those due to inlet guide vane (IGV) and rotor interactions. Noise reductions result from increased IGV–rotor spacing for the IGV–rotor configuration, and these reductions are further increased with the addition of the downstream stator. It has been possible to relate variations in the noise levels with a knowledge of local flow conditions in the vicinity of the blades. Author

N67-23301*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATION OF HYDRODYNAMIC JOURNAL BEARINGS IN SODIUM AT TEMPERATURES TO 800°F AND SPEEDS TO 12,000 RPM
Fredrick T. Schuller, William J. Anderson, and Zolton Nemeth Washington, NASA, Apr. 1967 31 p refs
(NASA-TN-D-3928) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A series of experiments was conducted with 1.5-inch-diameter hydrodynamic journal bearings in liquid sodium at 500° and 800°F at speeds to 12,000 rpm with unit loads to 31.1 pounds per square inch. Bearings of five different configurations were tested. Tilting-pad bearings were the most stable, followed in order by (1) a plain cylindrical bearing with a herringbone-groove journal, (2) a three-axial-groove cylindrical bearing, pressure fed from an axial shaft pump through a hole in the journal, and (3) three- and two-axial-groove cylindrical bearings. Stellite Star J material mated with Hastelloy X, titanium carbide (K184B), or Inconel had the best wear and seizure properties. Also titanium carbide (K184B) mated with a molybdenum-0.5 percent titanium alloy showed excellent promise. Surface damage to the tilting-pad-bearing pivots was observed in some tests, even after short runs at light loads. Existing theory is adequate for predicting the onset of instability in circular, axially grooved bearings. Author

N67-23306*# Mechanical Technology, Inc., Latham, N. Y.
STEADY-STATE AND DYNAMIC PROPERTIES OF JOURNAL BEARINGS IN LAMINAR FLOW REGIMES. I. TILTING-PAD BEARINGS
F. K. Orcutt Washington, NASA, Apr. 1967 112 p refs
(Contract NASw-1021)
(NASA-CR-732) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Calculated data on steady-state load capacity and friction torque and dynamic stiffness and damping coefficients are given for the tilting-pad journal bearing for laminar and turbulent flow conditions for Reynolds Numbers up to 12,000. Design curves are given for the four-pad, 80-degree pad arc, bearing for four values of preload coefficient. Some tabulated data are given for the three-pad, 100-degree pad arc bearing. The design data are verified and supplemented by experimental measurements of both steady-state and dynamic properties. Correlation between measured and calculated performance is good so it is concluded that the data are effective for design analysis purposes. Author

N67-23311*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDIES OF ROLLING-ELEMENT LUBRICATION AND FATIGUE LIFE IN A REDUCED PRESSURE ENVIRONMENT
David W. Reichard, Richard J. Parker, and Erwin V. Zaretsky Washington, NASA, 1967 20 p refs Presented at the Ann. Meeting of the Am. Soc. of Lubrication Engr., Toronto, 1–4 May 1967
(NASA-TM-X-52287) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Fatigue tests were conducted in a modified five-ball fatigue tester on SAE 52100 steel ball specimens, at atmospheric pressure and at the approximate lubricant vapor pressure with two different lubrication methods, using a super-refined naphthenic mineral oil as the lubricant. Additional tests were conducted with AISI M-50 ball specimens with polyphenyl ether lubricants. Differences in fatigue life, deformation, and wear with the mineral oil lubricant were insignificant regardless of the ambient pressure environment or lubrication method employed. Polyphenyl ether lubricants exhibited large amounts of wear both at atmospheric and reduced pressures indicating a lack of an elastohydrodynamic film with this lubricant under the stresses and sliding velocities present in the five-ball fatigue tester. Author

N67-23312*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE BEHAVIOR OF LUBRICATION SYSTEM COMPONENTS IN A VACUUM ENVIRONMENT
Donald H. Buckley Washington, NASA, 1967 27 p refs Presented at the 2d Aerospace Mech. Symp., Santa Clara, Calif., 4–5 May 1967
(NASA-TM-X-52284) CFSTI: HC $3.00/MF $0.65 CSCL 11H

Evaporation experiments were conducted with various fluids, greases, inorganic compounds, and soft metals to determine the vacuum environment effect on evaporation behavior. Friction, adhesion, and wear experiments were conducted with the various materials used in lubrication systems to determine the vacuum environment effect on friction, wear, and adhesion. The results indicated that while relatively high rates of evaporation may be obtained for conventional oil and grease lubricants these materials may be effectively utilized if concepts such as molecular flow seals are used to reduce evaporative losses. Further, for prolonged exposure to vacuum environment, many inorganic compounds and soft metal films have potential usefulness. In addition to evaporation losses, concern must be provided for the type of lubricant that is used. With conventional lubricants degassing of the fluids can present a problem. The results of sliding friction experiments in a vacuum environment indicate that there are basic metallic structures which have markedly superior friction, wear, and less tendency to adhere than now conventionally used bearing materials. Selective alloying of these metallic structures could be effectively used to prepare alloys specifically designed for use in lubrication mechanisms. Author

N67-23330*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
HYDRODYNAMIC JOURNAL BEARING PROGRAM Quarterly Progress Report, 29 Apr.–29 Jul. 1966
H. E. Nichols, W. D. C. Richards, R. J. Rossbach, and W. H. Bennethum 29 Jul. 1966 96 p refs
(Contract NAS3-6479)
(NASA-CR-72160; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 13I

In a journal bearing program for application to space power systems, work was completed on the fabrication of both the three lobe, and the self-aligning pivoted pad bearings. Evolution of the design and testing techniques for the piezoelectric force transducers continued, as did calibration of test hardware and its respective readout instrumentation. Being a continuation of experimental investigations paralleled by analytical studies, a comparision was made of the physical testing of bearing parameters with results based on theoretical assumptions. The high frequency power supply system was completed. Presently underway are studies on: evaluation of the displacement system with preliminary calibration of the Bently probes at an elevated temperature, displacement sensor summing circuits calibration, external scanning network and signal conditioning equipment. R.Li.

N67-23348# Naval Research Lab., Washington, D. C.
DRY-FILM LUBRICANTS FROM MOLYBDENUM DISULFIDE BONDED WITH MICROFIBROUS BOEHMITE
V. G. FitzSimmons and W. A. Zisman 22 Dec. 1966 25 p refs
(NRL-6468; AD-645889) CFSTI: HC $3.00/MF $0.65

Binders that have been tried for powdered lamellar dry lubricants have short-comings such as hindering the realignment of the lubricant particles or encapsulating the lubricant, making a wearing-in process necessary. A microfibrous form of colloidal alumina (boehmite) is shown to act as a superior nonencapsulating binder for molybdenum disulfide in the formation of dry lubricant films. Such films exhibit lower coefficients of friction than have been reported for molybdenum disulfide or graphite films bonded with any other material. These new lubricating coatings have good load-carrying ability and durability at any temperature below the decomposition temperature of molybdenum disulfide (700 F). Optimum performance of these boehmite-bonded films is obtained when (a) the ratio of fibrillar boehmite to MoS2 is near 0.20, (b) the film is 0.2 to 0.5 mil thick, (c) the substrate is hard and highly polished, and (d) the film is applied as an alkaline dispersion (pH = 10) and then dehydrated by baking at 550 F. Author (TAB)

N67-23366# Westinghouse Electric Corp., Pittsburgh, Pa.
ENGINEERING METHODS FOR THE DESIGN AND SELECTION OF MATERIALS AGAINST FRACTURE Final Report
Edward T. Wessel, William G. Clark, and William K. Wilson 24 Jun. 1966 400 p refs
(Contract DA-30-069-AMC-602(T))
(Rept.-66-9B4-315-R1; AD-801005) CFSTI: HC $3.00/MF $0.65

Various approaches to the brittle fracture problem were reviewed and evaluated in terms of their applicability for satisfying ATAC's need for engineering procedures to be applied to materials selection and design criteria for the prevention of fracture in the future use of high-strength materials. Linear-elastic fracture mechanics technology was selected as the most applicable approach. A comprehensive review of the state of the art in fracture mechanics technology is presented. The fracture mechanics data available in the literature for high-strength steels, aluminum and titanium alloys were reviewed and evaluated with respect to their validity as fracture toughness parameters. All applicable fracture toughness data are tabulated. Additional fracture toughness data are tabulated.

Additional fracture toughness data were generated in the program for HP-9-4-25 steel, 7079-T6 aluminum and 6Al-4V titanium. Crack growth rates as a function of the stress intensity were also determined for the steel and aluminum alloys. Engineering procedures and criteria for utilizing fracture mechanics technology were developed. TAB

N67-23424# United States Steel Corp., New York.
THE USE OF MECHANIZED NON-DESTRUCTIVE TESTING IN QUALITY CONTROL
D. A. Hayes Repr. from Sci. and Technol. v. 13, no. 9, 1966 p 1–23 Presented at Chicago Tech. Meeting of Am. Iron and Steel Inst., 20 Oct. 1965

Use of mechanized nondestructive testing methods for surface and internal defects in steel is considered. Installations which combine automatic material handling with magnetism for the detection of surface defects and sound for the detection of internal defects are described. The principle advantages of magnetic particle inspection equipment are to obtain the highest possible per cent of billets requiring no conditioning and the best bar quality possible when the billets are converted into finished products. A wheel type search unit is described for giving billets a combination surface and internal quality test with one handling operation. Other examples of mechanized nondestructive testing which offer an economical approach are cited. S.P.

N67-23441# Bureau of Mines, Pittsburgh, Pa.
EFFECT OF LIME STRUCTURE IN OXYGEN STEELMAKING
F. X. Tartaron and J. D. Ruschak 1967 46 p refs
(BM-RI-6901) CFSTI: HC$3.00/MF$0.65

Behavior of hard-burned quicklime was compared with that of soft-burned quicklime in an oxygen converter utilizing oxygen blowing in a rotating cylindrical vessel, set at a 30° to 60° angle to the horizontal and operated at a predetermined speed of rotation. Four pairs of tests were made, each comparing hard lime with soft lime. Three of the pairs differed from one another in the quantity of lime employed, and the fourth differed in blowing time. All four pairs showed an increase in yield when soft lime was used. Three of the pairs revealed that the ratio of the oxygen consumed with soft lime to the oxygen consumed with hard lime was the same as the ratio of metal yield with soft lime to the metal yield with hard lime. The fourth pair contained an error and could not be included. Finally, a close inverse relation was found between the combined iron in the slag and the combined lime in the slag. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-22535# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FORMATION OF CRYSTALLINE FILMS BY LASER EVAPORATION
P. D. Zavitsanos and W. E. Sauer Dec. 1966 20 p refs
(R66SD66; AD-804354) CFSTI: HC$3.00/MF$0.65

Using a pulsed ruby laser for the evaporation of germanium and gallium arsenide, it was observed that crystalline films of both materials can be prepared on unheated substrates of glass, sodium chloride and calcium fluoride. In the case of gallium arsenide, congruent deposition was observed. The films were 500 A–1000 A thick and were studied by reflection and transmission optical microscopy, as well as by electron diffraction. Author (TAB)

N67-22537# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
NOISE SOURCES DESCRIBING QUANTUM EFFECTS IN THE LASER OSCILLATOR
Herman J. Pauwels 1 Dec. 1966 117 p refs
(Contract DA-36-039-AMC-03200(E))
(TR-453; AD-646321) CFSTI: HC$3.00/MF$0.65

Quantum noise in the laser means those properties of the laser output that are caused by the quantum nature of the electromagnetic field and of the material systems and reservoirs with which it interacts. It is shown that a fully quantum-mechanical treatment of the laser can be formulated in a noise-source formalism, for which the noise sources are operators. A definition is given for the Gaussian character of operators in an appropriate ensemble, and it is shown that the noise sources for the laser are Gaussian. Special laser models are treated. The first model requires that the relevant relaxation time constants of the material be much smaller than those of the field; the second model drops this restriction. The final operator equations are solved by means of a linearization approximation that is only justified for operation points sufficiently above threshold. The first model takes the quantum nature of the field above threshold (or equivalently the commutator of certain noise-source operators) consistently into account; the second model neglects these quantum effects. The results are compared with the predictions of a semiclassical theory in which classical equations contain noise sources that correctly represent properties of the field below threshold. Author (TAB)

N67-22576# Library of Congress, Washington, D. C. Aerospace Technology Div.
PARAMETRIC OSCILLATION AND AMPLIFICATION AT OPTICAL FREQUENCIES Surveys of Foreign Scientific and Technical Literature
Charles Shishkevish 4 Nov. 1966 29 p refs
(ATD-66-131; TT-67-60545; Rept.-4; AD-645995) CFSTI: HC $3.00/MF$0.65

The report is based on Soviet open sources published 1962-1966 and one Western source published in 1966. The fourth in a series, the present report summarizes Soviet research on parametric amplification of light. The introduction presents background information on this research and includes a summary of the five sections in this report. The sections are: I. One-dimensional parametric amplification; II. Two-dimensional parametric amplification; III. Tunable coherent parametric oscillator operating at optical frequencies; IV. Theoretical analysis (A. Derivation of the basic equation and formulation of the boundary conditions; B. Analytical solutions for the transient regime in the cavity in the constant pump field approximation; C. Analytical solutions for the steady-state regime in the cavity; D. Numerical solutions for the transient and steady-state regimes in the cavity); V. Parametric amplification and oscillation in a medium pumped by coherent molecular vibrations excited by SRS. Author (TAB)

N67-22687# Navy Underwater Sound Lab., New London, Conn.
EXAMINATION OF SAFETY PROBLEMS ASSOCIATED WITH USL FIELD LASER OPERATIONS
Ralph J. Polley 14 Nov. 1966 27 p refs
(USL-772; AD-646009) CFSTI: HC$3.00/MF$0.65

The report discusses the eye safety problem created by projected field operations with a pulsed ruby laser. Information is presented to (1) support the establishment of 2 x 10 to the minus 9th power joules as a conservative value for the amount of laser energy tolerable at the eye pupil, (2) relate this threshold value to the laser beam characteristics and atmospheric effects involved in the USL experiments, and (3) describe the particular range geometry. Finally, procedures to ensure safe field operation are recommended. Author (TAB)

N67-22727# Honeywell, Inc., Hopkins, Minn. Corporate Research Center.
MECHANISMS OF LASER-SURFACE INTERACTIONS
Semiannual Report
J. F. Ready and E. Bernal G. Dec. 1966 85 p refs
(Contract DA-18-001-AMC-1040(X))
(AD-645473)

This report extends earlier measurements on particle emission produced when approximately 50 megawatts/sq cm pulses of radiation from a Q-switched ruby laser are absorbed at metal surfaces. Ion emission from carbon targets includes (Li6)(+), (Li7)(+), C(+), CH3(+), H2O(+), Na(+), and K(+) ions with energies up to 540 ev. Emission from single crystalline nickel targets includes ion species not observed before in this work, i.e., Na(++) and H2(+). Work using a quadrupole mass spectrometer to study neutral molecule emission has also been extended to carbon targets, which yield results similar to other target materials, and additional confirming work on the presence of high energy neutral molecules has been performed. Equipment under construction for measurement of the angular distribution of the ion emission is described. The expansion of the laser produced gas and resulting particle fluxes at a distance from the surface are discussed. Author (TAB)

N67-22838*# National Aeronautics and Space Administration, Washington, D. C.
THE "BLEACHING" EFFECT IN ZnS(Co) CRYSTALS UNDER THE INFLUENCE OF EXTREMELY LARGE PULSES OF A RUBY LASER [EFFEKT "PROSVETLENIYA" V KRISTALLAKH ZnS(Co) POD DEYSTVIYEM GIGANTSKIKH IMPUL'SOV RUBINOVOGO OPTICHESKOGO KVANTOVOGO GENERATORA]
L. N. Galkin Apr. 1967 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 2, 1966 p 315–316
(NASA-TT-F-480) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The transmission spectrum of cobalt-doped $N_{Co}=2\times10^{18}$ cm^{-3}) zinc sulfide crystals (1 mm thick) under the effect of a high-intensity ruby laser radiation was investigated at 694 mμ. The results indicate that 50% "bleaching" was attained at an incident intensity of approximately 50 Mw/cm^2, in a process during which a considerable portion of the Co^{2+} ions were excited from the $^4A_2(F)$ state to the $^4T_1(P)$ state. The relaxation time of the inverted transition was found to be high, $\tau=1\cdot10^{-9}$ sec, assuming $\sigma=1.6\cdot10^{-17}$ cm^{-2}. This indicates that only a negligible number of ions remains in the the metastable $^4T_2(F)$ state, transition from which into the lower $^4A_2(F)$ state is radiative and requires tens of μsec. Thus, the $^4T_1(P) \rightarrow {}^4A_2(F)$ and $^4T_2(F) \rightarrow {}^4A_2(F)$ transitions remain quasi-independent when the Co ions are exposed to short optical pulses. Author

N67-23044# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
NOISE PROPERTIES OF MICROWAVE MASER OSCILLATORS
Sergej Dmitrevsky Jul. 1966 98 p refs
(Contract Nonr-1866(16))
(TR-504; AD-643230) CFSTI: HC $3.00/MF $0.65

Rate equations describing transient behavior of the photon number of a maser oscillator exhibit damped sinusoidal solutions if longitudinal relaxation times are sufficiently long. The resonant nature of the transient is reflected in the shape of the noise power spectrum of the oscillator. The level of the noise can be described in terms of correlation functions satisfying differential equations. The form of the solutions of these equations allows one to interpret the oscillator noise in terms of a shot effect of the photon number and level populations. Experimental verification of the theoretical behavior has been carried out on a series of ruby microwave masers. The results obtained have been applied to establish limits of the sensitivity of ESR spectrometers utilizing maser oscillators. Author (TAB)

N67-23172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POLARIZED STIMULATED RADIATION OF GLASS, ACTIVATED BY NEODYMIUM
M. P. Vanyukov, V. I. Isayenko, and V. V. Lyubimov 7 Nov. 1966 8 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 3, no. 2, 1965 p 171–172
(FTD-HT-66-311; AD-646279) CFSTI: HC $3.00/MF $0.65

The report establishes experimentally that the introduction of a glass plate inclined at a small angle to the axis of a resonator into the resonator can insure almost complete polarization of the stimulated radiation of glass models activated by neodymium. Author (TAB)

N67-23449# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NUMBER 2
Feb. 1967 41 p refs Sponsored by DOD
CFSTI: HC $3.00/MF $0.65

Papers are presented covering these areas: a 37 Gc quartz maser using double inversion; large thermal radiation detectors; synthesis, structure, and properties of ferroelectric and antiferroelectric A_2BO_3 and ABO_3 compounds; thermostable fibers; controlling the properties of polymers; and space biology and medicine reviews on the effect of electromagnetic and magnetic fields on the central nervous system, and on wind generated sea wave are also given along with a series of abstracts from radiobiology papers. C.L.W.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-21952*# Israel Program for Scientific Translations, Ltd., Jerusalem.
LOW-TEMPERATURE STRENGTH OF METALS UNDER PULSED LOAD
E. S. Borovik, M. Sh. Mamedov, and V. G. Volotskaya *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 418–422 refs
(See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

It has been shown that in coils providing pulsed magnetic fields the coil material is subjected to brief load pulses. In this paper we present the results of our measurements on the strength of aluminum wire $3.1\cdot10^{-4}$m in diameter with pulse lengths $\tau=0.8\cdot10^{-4}$ sec, at temperatures of 293, 77, and 20°K, and the resistance increment of copper wire observed with loads of different magnitude and different repetitiveness. Author

N67-22066*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DEVELOPMENT AND EVALUATION OF MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE Quarterly Report, 1 Dec. 1965–28 Feb. 1966
P. E. Kueser, et al Mar. 1966 253 p refs
(Contract NAS3-6455)
(NASA-CR-54358; WAED-66.33E; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Details are presented on the continuing development of high temperature materials for eventual use in advance space

electric power systems. Martensitic alloys and cobalt base alloys were precipitation hardened, and the alloys with the best strength and magnetic properties are identified. In the dispersion strengthening research, iron–27% cobalt base materials provide better magnetic properties but have less tensile strength than the Co–B–Nb alloy. Continued creep testing is mentioned. In the high quality dielectric development, lightweight capacitors made with pyrolytic boron nitride wafers were found to have a high RC product and good thermostability. Bore seal development and combined material investigation under space environment conditions are discussed. Bond tests on Nb–1Zr joined to beryllia ceramics by the active metal braze, 60Zr–25V–15Nb, showed greater flexural strengths and greater ductility than any other active metal–braze system tested. Continued investigations on the stator, transformer, and solenoid test vehicles are also reviewed. N.E.N.

N67-22072*# National Aeronautics and Space Administration, Washington, D. C.
PROPERTIES AND CURRENT APPLICATIONS OF MAGNESIUM–LITHIUM ALLOYS
R. J. Jackson and P. D. Frost (Battelle Mem. Inst.) 1967 51 p refs
(NASA-SP-5068) GPO: HC$0.40; CFSTI: MF$0.65 CSCL 11F

The mechanical and metallurgical properties, the metallurgical processing techniques, and the aerospace and nonaerospace applications of magnesium–lithium alloys are discussed. Tabulated data are presented on the mechanical strength and other physical properties. Joining techniques by welding, brazing, bonding, and mechanical fastening are described. Details are given on cleaning and finishing procedures, and on casting and ingot production. N.E.N.

N67-22084# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
REFRACTORY-METAL ALLOY RESEARCH AND DEVELOPMENT
E. S. Funston and C. O. Tarr *In its* High-Temp. Mater. Program 30 Sep. 1966 p 55–75 refs (See N67-22081 11-22) CFSTI: HC$3.00/MF$0.65

Processes are described for production of Mo sheet from high-purity Mo powder compacts and for purification and processing Mo–Re–W alloy sheets in which weld porosity is at a minimum. Mo powders were produced both by fluoride dissociation and H_2–water vapor treatment. Fabricability of both types of Mo sheets is discussed as is the correlation between the presence of trace alkaline metals and weld porosity in refractory metals. Fabrication techniques for drawing small seamless tubes of refractory metals are discussed. NSA

N67-22089# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
EFFECT OF RADIATION ON HEAT-RESISTANT METALS AND ALLOYS
J. Moteff and J. P. Smith *In its* High-Temp. Mater. Program 30 Sep. 1966 p 119–131 refs (See N67-22081 11-22) CFSTI: HC$3.00/MF$0.65

Results of irradiation tests on Hastelloy and ferritic pressure vessel steels are reported. Specimens of the alloy irradiated and tested at 760°C show a reduction in rupture life by factors of 10 to 15 compared with unirradiated control specimens. It is indicated that long heat treatments are required to restore irradiation-induced loss in rupture life. Resistivity of ferritic steels is reduced as a result of ambient-temperature irradiation in some ranges, and reduction increases with increase of fast neutron flux. NSA

N67-22090# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
EVALUATIONS OF THE PLASTIC FATIGUE PROPERTIES OF HEAT-RESISTANT ALLOYS
J. Moteff and T. Sat *In its* High-Temp. Mater. Program 30 Sep. 1966 p 133–139 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF$0.65

Equipment and techniques for making low-cycle fatigue tests of stainless steels are described and results of tests made on 31 specimens of type 304 are shown. NSA

N67-22129 National Engineering Lab., Glasgow (Scotland).
EFFECT OF TEMPERATURE STEP DURING FATIGUE TESTING OF L65 ALUMINUM ALLOY AND A CARBON MANGANESE STEEL
A. A. Beveridge and M. Ormiston Mar. 1966 36 p refs
(NEL-221) CFSTI: $3.00

The effect of a major change in temperature, during fatigue testing, on the fatigue endurance of an aluminum alloy and a carbon–manganese steel has been investigated. Under some conditions of test the effect was beneficial, and detrimental under others. In a few cases only did the apparent damage approximate to a linear law. Author

N67-22176*# General Electric Co., Cleveland, Ohio. Lamp Metals and Components Dept.
THE PILOT PRODUCTION AND EVALUATION OF CHROMIUM ALLOY SHEET AND PLATE Final Report
L. J. Goetz, J. R. Hughes, and W. F. Moore 15 Mar. 1967 98 p refs
(Contracts NAS3-7901; NAS3-7919)
(NASA-CR-72184) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Approximately 180 lbs of chromium alloy sheet and plate of a nominal composition of Cr–5 w/o W–0.05 w/o Y were produced by a process based on inert atmosphere induction melting, hot extrusion, and warm rolling. Utilizing alloy material from this pilot production program, a second program was conducted which identified the temperature limits for warm rolling the Cr–5W–0.05Y alloy and examined the relationships between interstitial impurity content and mechanical properties. Author

N67-22301# Los Alamos Scientific Lab., N. Mex.
OBSERVATION OF THE MICROSCOPIC DISTRIBUTION OF OXYGEN AND CARBON IN METALS BY He^3 ACTIVATION
Dale M. Holm, John A. Basmajian, and William Mort Sanders 21 Nov. 1966 16 p refs
(Contract W-7405-ENG.36)
(LA-3515) CFSTI: HC $3.00/MF$0.65

The microscopic distribution of O_2 and C was observed by bombardment of metallographically polished samples with ^3He ions and autoradiography of the activated areas. Positrons from the activation products cause the exposure on nuclear track plates, and the positron annihilation radiation is used to determine both the proper exposure and the composite decay curve. Correlation of the unfolded decay curve with the autoradiograph indicates the isotope causing the exposure. Positional resolution of 0.0005 in. was obtained in samples having bulk C concentrations of about 250 ppM. Author

N67-22325# Argonne National Lab., Ill.
CREVICE-GALVANIC CORROSION OF ALUMINUM
S. Mori, J. E. Draley, and R. E. Loose Jun. 1966 9 p refs
(Contract W-31-109-ENG-38)
(ANL-6236) CFSTI: HC$3.00/MF$0.65

In water at 50°C, localized attack occurred on 1100 Al in the crevice formed by coupling to Cu, but not outside the crevice. More severe attack occurred where Cu deposited from a $CuSO_4$ solution onto Al alloy surfaces. Pure Al was not susceptible to this type of attack. Author (NSA)

N67-22330# Los Alamos Scientific Lab., N. Mex.
ON RELATING THE FLOW STRESS OF ALUMINUM TO STRAIN, STRAIN RATE, AND TEMPERATURE
John E. Hockett 1 Dec. 1966 60 p refs
(Contract W-7405-ENG-36)
(LA-3544) CFSTI: HC $3.00/MF $0.65

The need for basic information about the relationship between resistance to deformation (flow stress), temperature, strain, and strain rate, for the solution of metal-forming problems, is pointed out. Early attempts to satisfy the need are mentioned. A brief description of a machine called a cam plastometer is given, followed by some typical results obtained by testing commerically pure Al in the machine. Next, a program of testing Al in compression over a wide range of constant true-strain rates (0.1 to >200 sec^{-1}) and a moderately broad range of temperatures (223° to 673°K) is described. The results of this program are presented in the form of true-stress vs true-strain curves. The data in these curves are presented in the form of relationships between true stress and true-strain rate in semilogarithmic and log-log form, as functions of temperatures—for several true strains. Finally, true stress is displayed as a function of log true-strain rate and absolute temperature for four different true strains. Author (NSA)

N67-22333# Oak Ridge National Lab., Tenn.
MASS-TRANSFER EFFECTS IN SOME REFRACTORY-METAL–ALKALI-METAL–STAINLESS STEEL SYSTEMS
J. R. Di Stefano Nov. 1966 28 p
(Contract W-7405-ENG-26)
(ORNL-4028) CFSTI: HC $3.00/MF $0.65

Dissimilar-metal interactions between Nb or Nb–1% Zr and type 316 or 318 stainless steel in Na or NaK were investigated in static capsules at 816 to 982°C. The principal interaction was the transfer of C and N_2 from the stainless steel to the Nb or Nb alloy. Complex carbide-nitride layers formed on the surface of the Nb and N_2 but not C diffused appreciably into the Nb. The subsurface N_2 pickup greatly increased tensile strength and decreased ductility. The amount of C and N_2 transfer depended on temperature, exposure time, and ratio of surface areas of the dissimilar metals. The transfer was independent of stress and occurred to the same extent with types 316 and 318 stainless steels. Author (NSA)

N67-22391# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
THE MECHANICAL PROPERTIES OF DILUTE URANIUM ALLOYS AT ELEVATED TEMPERATURES
M. F. Nolan 1 Aug. 1966 64 p refs
(Contract W-14-108-ENG-8)
(MCW-1505) CFSTI: HC $3.00/MF $0.65

High temperature tensile tests and prolonged hot hardness tests of U alloys were conducted for correlation of results with in-reactor behavior. Tensile test techniques are discussed for one alloy tested at 25°C and between 100 and 600°C at 100° intervals. The mechanism of flow and fracture is discussed in terms of temperature structure, strain, and strain rate. Activation energy values for plastic flow are presented. Hot hardness tests at 400°C under a 600 pound load applied for 22 hours are described for both spring-loaded and level-loaded equipment. The data indicated that the dia of indentation decreased as the alloy content of the U increased. The resistance to indentation, however, appeared to be a function of the degree of solid solution hardening and not of the total alloy content. A sensitive response to thermal history therefore seemed likely. A correlation with resistance to in-reactor swelling was not obtained. Author (NSA)

N67-22439*# State Univ. of New York, Stony Brook. Coll. of Engineering.
THERMODYNAMIC PROPERTIES OF INTERSTITIAL ELEMENTS IN THE REFRACTORY METALS Semiannual Report, 1 Jun.–1 Dec. 1966
R. Singh and L. Seigle 1 Dec. 1966 24 p refs
(Grant NGR-33-015-035)
(NASA-CR-83391; SAR-1) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The thermodynamic properties of C dissolved in solid Mo, W, Nb, and Ta were estimated from the phase equilibrium diagrams of the respective metal-carbon systems, and knowledge was obtained of the free energies of formation of the di-metal carbides in equilibrium with the terminal solid solutions. Values of the partial molar heats and vibrational entropies of carbon in the terminal solid solutions are presented, and the accuracy of the calculations is discussed. Author

N67-22463# National Bureau of Standards, Washington, D. C.
HEAT TREATMENT AND PROPERTIES OF IRON AND STEEL
Thomas G. Digges, Samuel J. Rosenberg, and Glenn W. Geil 1 Nov. 1966 50 p refs
(NBS-MONOGRAPH-88) CFSTI: HC $3.00/MF $0.65

The basic principles involved in the heat treatment of iron and steels are presented in simplified form. General heat treatment procedures are given for annealing, normalizing, hardening, tempering, case hardening, surface hardening, and special treatments such as austempering, ausforming, martempering and cold treatment. Chemical compositions, heat treatments, and some properties and uses are presented for structural steels, tool steels, stainless and heat-resisting steels, precipitation-hardenable stainless steels and nickel-maraging steels. Author

N67-22476# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Lab.
WEAR RATES OF METALS AND OXIDES IN 80° AND 160°F HIGH PURITY WATER
J. T. Dunn Aug. 1966 79 p refs
(AECL-2602) CFSTI: HC $3.00/MF $0.65

The wear rates of 157 material combinations were determined as 3/4 in. i.d. x 3/4 in. long sleeve bearings in high purity pH 7 water under loads of 20 to 250 lbs at speeds of 20 to 280 rev/min for periods of 4 to 14 days. These wear results were reported as a volume rate of wear, called specific wear, which can be used directly with the load, size, and expected life of sliding contacts to predict the approximate depth of wear. The specific wear of materials evaluated ranged from 0.3 to 12,000 and the best materials (those with low specific wear) were the hard oxides on zirconium alloys and on a proprietary nickel–tin–bismuth alloy. In over half of all tests run the wear rates decreased with increasing sliding distance. To numerically describe this wear-in behavior a wear-in factor was defined which indicates the rate of change of wear rate with distance. This wear-in effect was a function of speed and load and it was felt to be due to the gradual build-up of hydrodynamic thin film lubrication in the bearing wear scar. Author

N67-22676# Naval Research Lab., Washington, D. C.
PREPARATION OF CrFe ALLOYS
J. E. Cox 5 Oct. 1966 18 p refs
(NRL-6457; AD-641898) CFSTI: HC $3.00/MF $0.65

High purity, homogeneous samples were prepared for a study of the thermoelectric power and electrical resistivity of the CrFe system. The use of an induction heater for making these samples at first appeared to be ideal because of its ability to generate high temperature and its magnetic stirring properties. However, the chromium component of the molten alloy at this temperature is quite reactive, and a crucible material was not found

that would remain inert and intact. The next device that was tried, an arc furnace, did fill the requirement of being able to contain the melt without reacting with it. The samples were successfully melted on a water-cooled copper hearth with an arc initiated from a water-cooled tungsten tip, under one-half atmosphere of argon. The samples made were of 5-9s purity and were homogeneous to within plus or minus 0.2% of their entire volume of some 2 cc. Further difficulty was encountered in reducing the rough, as-cast ingot to a usable geometry. In this case a uniform cylinder was desired of approximately 1/8-inch diameter and 2-1/2-inch length. This difficulty was overcome by spark-erosion machining of the rough ingot to near cylindrical form, followed by centerless grinding to a perfect cylinder. Author (TAB)

N67-22798# Saunders-Roe, Ltd. (Gt. Brit.)
INFLUENCE OF CHEMICAL CONTOURING ON THE FATIGUE AND SUSTAINED LOAD PROPERTIES OF HIGH TENSILE STEEL SHEET
Aeronautical Research Council, May 1964 29 p Supersedes ARC-26155; see X67-15739
(ARC-CP-812; ARC-26155) CFSTI: HC $3.00/MF $0.65

Reverse bend fatigue and sustained load tests were carried out on three low alloy steel sheet materials, 1% Cr–Mo, 3% Cr–Mo–V, and 5% Cr–Mo–V, heat treated to 88, 103, and 121 tsi, respectively, and chemically contoured in acid etching solutions. All three steels showed the lowest fatigue properties in the as received condition, intermediate properties after machining or grinding, and the highest properties after chemical contouring. The high properties after chemical contouring were sometimes, but not always, due to removal of a decarburized surface layer. The chemical contouring process caused no failures under sustained load at high proportions of the notched tensile strength. Phosphate treatment after chemical contouring caused a slight reduction of fatigue properties and very slight embrittlement. Author

N67-22841*# Aerojet-General Corp., Azusa, Calif.
WELDED TRANSITION JOINTS OF 9Cr–1Mo ALLOY STEEL/316:66 FOR SHORT LIFE (100 HOURS MAXIMUM) APPLICATION
R. A. Mendelson 27 Feb. 1964 24 p refs
(NASA-CR-72205; TM-390-63-4-172) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Welding parameters and elevated temperature aging and strength characteristics of transition joints between 9Cr–1Mo alloy steel and 316 stainless steel were investigated. Three weld filler alloys were evaluated: 316L, 505, and Inco A. Test capsules, each containing a transition joint, were fabricated from 1 in. OD × .109 in. wall tubing. They were subjected to 43 temperature/pressure cycles, and 1894 cumulative hours of exposure to pressure and/or temperature. All specimens completed the temperature/pressure test sequence without failure; however, one specimen failed in bend tests after exposure. Elevated temperature exposure produced carbon migration on joints fabricated using AISI 505 or 316L weld rod. Author

N67-22848*# Aerojet-General Corp., Azusa, Calif.
RESULTS OF SHORT-TIME TENSILE TESTS OF 9Cr–1Mo ALLOY BAR
C. J. Romero 27 Jan. 1964 19 p refs Revised
(NASA-CR-72203; TM-390-64-4-184, Rev.) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Specimens of hot-forged bar of 9Cr–1Mo alloy steel were tested at 70, 800, 1000, 1200, 1300, and 1325°F. A metallurgical history of the as-received bar is presented. Typical short-time tensile test data and stress–strain curves were obtained at each temperature. The data is summarized in curves of average values plotted vs test temperature and compared with minimum values previously derived from the literature. Author

N67-22851*# Aerojet-General Corp., Azusa, Calif.
EVALUATION OF COLDWELDED BUTT JOINT TRANSITION PIECE
R. A. Mendelson 21 Jan. 1964 13 p ref
(NASA-CR-72204; TM-390-64-4-183) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Ten specimens of electrolytic tough pitch copper coldwelded to 6061-T6 aluminum were received. Tension, torsion, and reverse bend tests were performed as well as a metallurgical evaluation of the joint. The test results indicate that the joint should be satisfactory for use in the electrical high-current bus system. Author

N67-22856*# Aerojet-General Corp., Azusa, Calif.
ALUMINUM-TO-COPPER COLDWELDED JOINTS FOR SNAP-8 ELECTRICAL TERMINAL APPLICATIONS
H. E. Bleil 16 Jul. 1965 7 p refs
(NASA-CR-72194; TM-4923-65-4-309) CFSTI: HC $3.00/MF $0.65

Joints of ETP copper coldwelded to 6061-T6 aluminum were evaluated by mechanical testing and metallographic examination after thermal exposure at 350°F for times up to 3000 hours. It was concluded that the joint is adequate for the intended use as SNAP-8 electrical terminal transition pieces where they will be exposed to a maximum temperature of 350°F for 10,000 hours. Author

N67-22884*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.
INVESTIGATION OF THE ADHESION OF METALS IN ULTRA-HIGH VACUUM
M. J. Hordon and J. R. Roehring Dec. 1966 52 p refs
(Contract NAS1-2691)
(NASA-CR-66279) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Adhesion–friction tests were conducted at vacuum levels below 1×10^{-9} torr for annealed copper, titanium and tungsten. Prior to contact under loads up to 1000 lbs, mating cup-and-cone shaped specimens were subjected to xenon ion gas bombardment or rotational self-abrasion. Subsequently, residual shear torque, frictional torque, and normal adhesion forces were measured. Author

N67-22889*# Aerojet-General Corp., Azusa, Calif.
EVALUATION OF KOLDWELDED BUTT JOINT TRANSITION PIECE
R. A. Mendelson 17 Apr. 1964 11 p
(NASA-CR-72198; TM-390-64-4-220) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Five specimens of Koldwelded joints, 6061-T6 aluminum to annealed pure nickel, were evaluated. Tension and torsion tests and metallurgical evaluation were performed on as-received and thermally-cycled (10 cycles between 70° and 500°F) specimens. The joint was found to be of a metallurgical nature with a narrow diffusion zone. All mechanical tests produced failure in the aluminum. Author

N67-22893* Aerojet-General Corp., Azusa, Calif.
THE MECHANICAL PROPERTIES OF 9%Cr, 1%Mo (9M) STEEL ALLOY
Carlos J. Romero 27 May 1963 43 p refs
(NASA-CR-72207; TM-390-63-4-116) CFSTI: $3.00 CSCL 11F

Ten thousand hour tensile data with complete chemistry, fabrication, and heat treatment history were accumulated, correlated, plotted, interpreted, and extrapolated to 1400°F to issue 1% creep and stress-rupture design values to be used between 1300 and 1350°F for a 9% chromium, 1% molybdenum (9M) alloy steel to be used in the fabrication of components for the SNAP-8

system. Equations were used to calculate curves for approximate endurance limits at various temperature for this alloy. Preliminary correlations were established between composition elements, heat treatment, and 10,000 hour strength levels. Microphotographs and an isothermal transformation diagram are used to indicate that a finely dispersed carbide network is desired for 10,000 hour service at 1300 to 1350°F as required by the SNAP-8 system. It is concluded that a formal statistical study is desirable to establish optimum alloy composition for maximum 10,000 hour strength at temperature and that tests should be performed to obtain endurance limit values, short-time tensile stress–strain curves at temperatures of interest, and to establish potential fabrication difficulties due to alloy upgrading. Author

N67-22908# Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
CORROSION OF STAINLESS STEELS IN HIGH TEMPERATURE WATER AND STEAM
M. Warzee, W. R. Ruston, P. de Dorlodot, J. Hennaut, and J.-Ph. Berge (EURATOM) Brussels, EURATOM, Dec. 1966 14 p refs Presented at the 3rd Intern. Congr. on Metallic Corrosion Moscow, 16–25 May 1966
(Contract EURATOM-089-62-7 RDB)
(EUR-2857.e; EURAEC-1665) CFSTI: HC $3.00/MF $0.65

The corrosion of stainless steels in steam increases regularly between 200 and 300°C. This is not so in water: there, corrosion as function of temperature shows a marked maximum around 250°C for AISI 410 steel. For AISI 304 steel the maximum, which was not actually observed, must lie at a lower temperature. The quantity of dissolved metal is responsible for the maximum. It was shown that magnetite crystals grow out of the solution and that this redeposition may cause underestimation of corrosion values obtained in static autoclave tests. The observed phenomenon is of great technical significance because the crystallization of magnetite from solution may cause mass transfer from cooler to hotter parts in nuclear reactors cooled with water and operating around 300°C. Author

N67-22957# Aktiebolaget Atomenergi, Stockholm (Sweden).
HIGH TEMPERATURE TENSILE PROPERTIES OF UNIRRADIATED AND NEUTRON IRRADIATED 20Cr–35Ni AUSTENITIC STEEL
R. B. Roy and B. Solly Dec. 1966 28 p refs
(AE-260) CFSTI: HC $3.00/MF $0.65

The tensile properties of an unirradiated and neutron irradiated (at 40°C) 20% Cr, 35% Ni austenitic steel were studied at 650°C, 750°C and 820°C. The tensile elongation and mode of fracture (transgranular) of unirradiated specimens tested at room temperature and 650°C are almost identical. At 750°C and 820°C the elongation decreases considerably and a large part of the total elongation is nonuniform. Furthermore, the mode of fracture at these temperatures is intergranular and microscopic evidence suggests that fracture is caused by formation and linkup of grain boundary cavities. YS and UTS decrease monotonically with temperature. Irradiated specimens show a further decrease in ductility and an increase in the tendency to grain boundary cracking. Irradiation has no significant effect on the YS, but the UTS are reduced. The embrittlement of the irradiated specimens is attributed to the presence of He and Li atoms produced during irradiation and the possible mechaniams are discussed. Prolonged annealing of irradiated and unirradiated specimens at 650°C appears to have no significant effect on tensile properties. Author

N67-22961# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
INFLUENCE OF THE CYCLE RATIO ON THE FATIGUE STRENGTH OF DRILLED FLAT BARS OF St 37 STEEL MATERIAL. PART B: MULTI-STEP AND PROGRAM TESTS [EINFLÜSS UNTERSCHIEDLICH HOHER UND HAEUFIGER VORBELASTUNGEN AUF DIE SCHWINGFESTIGKEIT GEBOHRTER FLACHSTAEBE AUS St 37 TEIL B: MEHRSTUFEN- UND BETRIEBSFESTIGKEITSVERSUCHE]
E. Gassner and W. Schuetz 1966 116 p refs
(FB-58, Pt. B; ICAF-348) CFSTI: HC $3.00/MF $0.65

The influence is determined of various cycle ratios on finite life and fatigue limit of the flat bars of MR St 37 material (mild steel); the cycle ratio is determined by reference to S–N curves which are characterized by arithmetic mean and standard deviation. A very low cycle ratio reduces both finite life and fatigue limit. Author

N67-22994# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE EFFECTS OF DISSOLVED OXYGEN UPON THE MECHANICAL PROPERTIES OF ZIRCONIUM-2.5 WT % NIOBIUM ALLOY
J. R. Kench, J. H. Foley (English Elec. Co.), and S. A. Aldridge (CRNL) Oct. 1966 35 p refs
(AECL-2623) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

Specimens of Zr-2.5 wt% Nb were prepared with various levels of oxygen content, ranging from 170 to 2000 ppm by weight. In a preliminary investigation the $(\alpha+\beta)/\beta$ transus temperature was determined metallographically. The observed variation with oxygen content was in good agreement with other results available. Hardness values, at room temperature, increased with increasing oxygen content up to ≈800 ppm, then less rapidly up to 2000 ppm. Results were indistinguishable for specimens that had been (a) β-quenched, (b) $(\alpha+\beta)$-quenched, (c) β-quenched and aged, or (d) $(\alpha+\beta)$-quenched and aged; but a relatively large scatter in all results was noteworthy. The yield and ultimate tensile strengths, the reduction of area and elongations of both β-quenched and $(\alpha+\beta)$-quenched specimens were obtained as a function of oxygen content from tensile tests conducted at room temperature and 300°C. The effect of the oxygen on the properties differed for different test temperatures and for different heat treatments, but in all instances a discontinuity was apparent around 800 ppm. The results are tentatively explained in terms of competition between solution (oxygen) and precipitate (niobium) hardening. Author

N67-23015# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
FATIGUE STRENGTH OF NOTCHED AND UNNOTCHED SPECIMENS OF Al Mg Si 1 (6061 T-6) AND Al Mg 5 (5056) [SCHWINGFESTIGKEIT VON Al Mg Si 1 UND Al Mg 5 IM GEKERBTEN UND UNGEKERBTEN ZUSTAND]
S. Schuetz 1966 123 p refs In GERMAN; ENGLISH summary
(FB-57; ICAF-345) CFSTI: HC $3.00/MF $0.65

Finite life and fatigue limit of the Al Mg Si 1 and Al Mg 5 materials are determined for various stress ratios R and mean stresses S_m using flat bars with stress concentration factors K_t=1.03 and 2.4 under axial loading. The tests have been designed and evaluated on a statistical basis; the test results are presented in a form suitable for design purposes. Characteristics describing the behaviour under repeated loading are compared with similar characteristics of other materials. Author

N67-23102# Naval Research Lab., Washington, D. C.
CORROSION OF METALS IN TROPICAL ENVIRONMENTS. PART 7: COPPER AND COPPER ALLOYS—SIXTEEN YEARS' EXPOSURE

C. R. Southwell, C. W. Hummer, Jr., and A. L. Alexander 28 Oct. 1966 34 p refs
(NRL-6452; AD-644930) CFSTI: HC$3.00/MF$0.65

The corrosion of copper and nine wrought copper alloys is reported for exposures in five tropical environments for one, two, four, eight, and sixteen years. Weight loss, pitting, and change in tensile strength were measured to evaluate corrosion resistance. Higher corrosion rates are shown for tropical sea water immersion and tropical marine atmosphere than similar exposures in temperate climates. Of the various alloys studied, 5% Al bronze showed the highest general corrosion resistance; its 16-year losses in sea water were only 1/5 that of copper. Copper and the high-copper alloys were resistant to all environments and generally had decreasing corrosion rates with time of exposure. Tensile tests revealed heavy dezincification in the lower-copper brasses when exposed in marine environments, and for two of the brasses in fresh water immersion. As a result of the decreasing corrosion rates or dezincification, antifouling properties of copper alloys decreased with time of exposure. All were moderately to heavily fouled after 16 years in sea water. Galvanic effects were pronounced in tropical sea water. The corrosion of copper alloys was accelerated appreciably by contact with stainless steel (316) of 1/7 their area, while similar carbon steel strips gave effective cathodic protection of plates of brass and bronze over the long term. Author (TAB)

N67-23108# Cornell Univ., Ithaca, N. Y.
EFFECT OF CARBON ADDITIONS ON THE SHEAR MODULUS OF TUNGSTEN AND A TUNGSTEN–3% RHENIUM ALLOY Interim Technical Report
D. R. Hay (Ph.D. Thesis), and E. Scala [1965] 22 p refs
(Contract DA-31-124-ARO-D228)
(ARO-D-228; Rept.-4917-1-MC; AD-645762) CFSTI: HC $3.00/MF$0.65

Chemical interactions of rhenium and carbon with the tungsten matrix were studied by observing changes in shear modulus with composition. The addition of 3% rhenium to tungsten decreased the shear modulus from 19,600,000 psi to 16,100,000 psi. Carbon additions did not change the modulus of the pure tungsten, but 70 ppm carbon increased that of the alloy to 18,700,000 psi. The observed alloying behavior was correlated to the electronic structure. The changes in modulus were attributed to changes in the electronic structure of the metal upon alloying. Differences in the behavior of carbon in the pure tungsten and the alloy were related to an increased carbon solubility in the alloy which in turn is a function of the electronic structure of the metal. Author (TAB)

N67-23115# Marine Engineering Lab., Annapolis, Md.
MECHANICAL PROPERTIES OF THICK-PLATE Ti–6Al–4V/ALLOY
A. G. S. Morton Jan. 1967 37 p refs
(MEL-266/66; AD-645936) CFSTI: HC$3.00/MF$0.65

Three grades of Ti-6Al-4V, representing variations in oxygen level and mill processing, were evaluated on the basis of strength, toughness, stress corrosion, and fatigue. The results indicate that the Ti-6Al-4V alloy is a strong candidate for pressure hull applications, provided that a processing schedule can be developed which gives a tough, weldable alloy at a 110/115 yield-strength level. Author (TAB)

N67-23124# Franklin Inst., Philadelphia, Pa. Research Labs.
THE MICROSTRAIN REGION IN HIGH PURITY REFRACTORY METALS Quarterly Progress Report, Sep. 1–Nov. 30, 1966
Heinrich L. Prekel, Alan Lawley, and Hans Conrad Nov. 1966 21 p refs
(Contract Nonr-4434(00))
(Q-B2195-3; QR-3; AD-645213) CFSTI: HC$3.00/MF$0.65

Dislocation velocity measurements at room temperature on molybdenum single crystals by the etch-pitting method are described. It is shown that the stress dependence of the dislocation velocity obeys the relationship v = (tan/tan sub o) to the mth power with m about 6.4 and tan sub o about 5.5 Kg mm to the minus 2nd power. It is also shown that this relationship can be derived directly from thermal activation theory and that the results support the thermally activated overcoming of the Peierls hills as the rate controlling process in the plastic deformation of molybdenum. Author (TAB)

N67-23182# Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering.
THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION Quarterly Report, 1 Jul.–30 Sep. 1966
Thomas B. Cox 30 Sep. 1966 18 p refs
(Contract AT(40-1)-3208)
(EURAEC-1755; QR-438-9) CFSTI: HC$3.00/MF$0.65

As part of an investigation to determine relationship between N content of austenitic stainless steels and susceptibility to stress-corrosion cracking, experiments were conducted in which the solubility of N_2 in AISI Types 304 and 308 stainless steel wires was determined. NSA

N67-23184# Chantiers de l'Atlantique Saint-Nazaire (France).
STUDY OF THE AUSTENITIC GRAIN GROWTH OF FIVE STEELS UNDER THE INFLUENCE OF HEAT CYCLES SIMULATING VERTICAL SLAG WELDING CONDITIONS. EXECUTION OF FURTHER CYCLES Special Report, 1 Apr.–30 Jun. 1966
30 Jun. 1966 20 p Transl. into ENGLISH from French
(Contract EURATOM-056-61-12 RDF)
(EUR-2860; EURAEC-1668)

A study (Study No. 985) was made of grain growth during heat cycles in five Mn–Mo and Mn–Ni–Mo steels: Wel Monix, W B 35, P M 24, 15 MDV 4.05, and 1.2 MD 0.7. The heat cycles were carried out at different heating rates, and specimens were examined by hot and standard microscopy. The results at 1150°C are compared with those at 1250°C (Study No. 960), and it is concluded that the tests do not permit classification of the steels in order of overheating resistance. The grain of W B 35 steel is perhaps a little larger than that of the others. The heating rate has no effect on the final grain size. NSA

N67-23185# California Univ., Berkeley. Lawrence Radiation Lab.
RADIATION INDUCED DEFECTS IN MOLYBDENUM
Prakash Rao (M.S. Thesis) Sep. 1966 47 p refs
(Contract W-7405-ENG-48)
(UCRL-17078) CFSTI: HC$3.00/MF$0.65

A study, using transmission electron microscopy and field-ion microscopy, of the substructure of neutron-irradiated Mo revealed induced damage in the form of small dislocation loops. Bright field electron micrographs give a quantitative estimate of the extent of this damage, and strain contrast imaging in dark field allowed the loop plane and Burgers vector to be established. Analysis of these induced defects, using different imaging conditions in dark field, showed that the loops are predominantly of the type |110| ⟨111⟩ [i.e., loop plane |110| and Burgers vector (a/2) ⟨111⟩]. The extension and applicability of the strain contrast theory to radioinduced defects in BCC metals was examined, particularly its usefulness in predicting the interstitial or vacancy character of the defects. Contradictions arise when low-order reflections are used, but the results are less ambiguous for high order reflections and edge on defects. The evidence presented indicates that the defect structure is primarily interstitial. The irradiation behavior of Mo is discussed in terms of present observations. Interstitial impurity atoms play an important role in determining the nature of defects present in the as-irradiated and irradiated–annealed states. Author (NSA)

N67-23186# Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
STUDIES OF STEEL CORROSION IN HIGH TEMPERATURE WATER AND STEAM
30 Oct. 1966 89 p Transl. into ENGLISH from French
(Contract EURATOM-087-66-TEEB RD)
(EUR-3304; EURAEC-1744; QR-16) CFSTI: HC $3.00/MF $0.65

The study of the recrystallization conditions of various grades of milled stainless steels was continued. It was found that Uranus 30 steel offers good behavior under oxidation, after surface treatment, at temperatures at which standard 18-10 steels tend to deteriorate. The study of grain size, with or without prior selective oxidation treatment, was initiated on various grades of stainless steels. The initial results, for oxidation pretreatment at 800°C, indicate definite influence of the grain size under these conditions. The effect is quantitatively inadequate, however. Long-duration tests in superheated steam at 500°C on AISI 304 L steel show that the work-hardening depth obtained by grinding is insufficient to guarantee satisfactory steel behavior. Tests in superheated steam at 500°C with 20 ppM oxygen added do not show any weight differences from the tests carried out without oxygen. In the tests with oxygen added, the oxide skin formed on a surface work-hardened 304 steel remains of the spinel type whereas that formed on electrolytically polished steel consists primarily of α-Fe_2O_3. NSA

N67-23219# Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye (France).
STUDY OF THE BASE METAL INTENDED FOR RESEARCH ON THE BRITTLE FRACTURE OF LARGE WELDMENTS. STUDY OF ANISOTHERMAL STRESS-RELIEF ON AMMO STEEL Quarterly Report, Jul. 1–Sep. 30, 1966
24 Nov. 1966 10 p
(Contract EURATOM-031-64-5-TEEF (RD))
(EUR-3311; EURAEC-1756; QR-10) CFSTI: HC $3.00/MF $0.65

Magnetic analysis was conducted on the transformations in AMMO steel during heat cycles simulating a welding cycle, and graphs are presented for temperatures of 900 to 1250°C. Stress-relief heat cycles were applied to AMMO steel in the initial state and in the pretreated state simulating the heat-affected zone of a weld. Stress–temperature graphs are presented for treatment temperatures of 900 and 1100°C. NSA

N67-23277* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A CASE HISTORY OF TITANIUM STRESS CORROSION IN NITROGEN TETROXIDE
Robert E. Johnson, George F. Kappelt (Bell Aerosystems Co., Buffalo), and Larry J. Korb (North American Aviation, Inc., Downey) [1966] 20 p Presented at the 1966 Natl. Metals Congr., Chicago
(NASA-TM-X-59615) CSCL 11F

An investigation of the incompatibility of titanium in certain grades of nitrogen tetroxide is discussed. The methodology used in its resolution points out some of the dangers associated with compatibility testing. The methodology also presents some of the difficulties associated with coordinating an investigation involving many contractors and agencies. The techniques employed in this investigation are described in considerable detail for the benefit of investigators with similar problems. Author

N67-23323*# TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.
GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Quarterly Report, 26 Oct.–27 Dec. 1966
J. C. Sawyer and E. A. Steigerwald 17 Jan. 1967 135 p refs
(Contract NAS3-2545)
(NASA-CR-72185; QR-14) CFSTI: HC $3.00/MF $0.65 CSCL 11F

This report is part of a study to obtain design creep data on refractory metal alloys for use in advanced space power systems. Long-time (10,000 hour) creep design data are provided for the tantalum-base alloy T-111, the molybdenum-base alloys TZC and TZM, tungsten, and tungsten alloys. Tables indicating composition of the alloys, material form, range of test temperatures, and heat treatments are presented. A detailed review of the available processing histories of the alloys is given. Geometries of the test specimens and their orientation with respect to the working direction are shown. K.W.

N67-23334*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUALITATIVE EFFECTS ON SAFETY AND CONSTRUCTION MATERIALS OF 1300°F SODIUM–POTASSIUM SPRAY IN AIR AND NITROGEN
John M. McGee and Armen S. Asadourian Washington, NASA, Apr. 1967 28 p refs
(NASA-TM-X-1365) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Three tests were conducted in open containers with NaK spray at 1300°F in air impinging on various safety and construction materials. Two tests were conducted in closed containers, one with air and one inerted with gaseous nitrogen. Rubber-asbestos welding-blanket material and chromated leather withstood attack best among the materials tested although no material exhibited an ultimate resistance to attack by the NaK spray. Of the construction materials tested, the 1900°F asbestos insulation material withstood attack the best, but it also did not exhibit an ultimate resistance to attack. A small amount of smoke was produced in the inerted container from the burning of a chromated-leather glove and a face shield. Some of the smoke was also produced by NaK burning in the 2-percent residual oxygen content in the container. The chromated leather exhibited no better resistance to direct NaK spray in an inerted atmosphere. The period of effective resistance of the plastic face-shield material currently being used was very limited in comparison with the chromated leather. Thicker face-shield material would increase its resistance time to more closely coincide with that of the resistance of chromated leather. Author

N67-23408# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 365. A STUDY OF THE ISOTHERMAL SECTION AT 1200°C OF THE TERNARY SYSTEM W–Mo–Zr
Yu-Chih Chuang and Kuo-Nien Ni 2 Feb. 1967 12 p refs Transl. into ENGLISH from Chin Shu Hsueh Pao (Peking), v. 9, no. 2, Apr. 1966 p 176–180
(JPRS-39757; TT-67-30405)

The isothermal section at 1200°C of the ternary system W–Mo–Zr was studied by means of metallographic and X-ray analysis. It is confirmed that in this section there exist three very narrow single phase regions of W–Mo solid solution α, Zr solid solution β, and a ternary intermediate phase ϵ, as well as two broad binary phase regions of $(\alpha+\epsilon)$ and $(\epsilon+\beta)$. The α and β phases have body-centered cubic structure. The lattice parameter of the ϵ phase varies linearly from ZrW_2 to $ZrMo_2$. The measurement of the alloy hardness coincides with the results of metallographic and X-ray analysis. Author

N67-23448# Bureau of Mines, Rolla, Mo.
EFFECTS OF RARE-EARTH ADDITIONS ON PLAIN-CARBON STEEL
P. G. Barnard 1967 30 p refs
(BM-RI-6907) CFSTI: HC $3.00/MF $0.65

The Bureau of Mines investigated the effects of various additions of rare-earth metals or rare-earth oxides on the mechanical properties of cast and wrought plain-carbon steels. Rare-earth metals, as misch metal, were added to medium-carbon steel in amounts to 0.70 weight-percent; rare-earth oxides, as a commercial

mixture, were added in amounts to 1.50 weight-percent. The melting and casting of conditioned steels were done in a vacuum-induction furnace, to avoid formation of oxides from the melting atmosphere and to provide better control over chemical composition. At room temperature, data for tensile strength, yield strength, elongation, and hardness of cast and wrought steels were obtained by standard testing equipment and procedures. Impact tests were conducted on as-cast steel specimens. The greatest amount of tensile ductility and impact strength was obtained in as-cast steel with 0.50 to 0.70 weight-percent misch metal additions. No significant improvement on mechanical properties was indicated in wrought steels containing rare-earth metal additions in the range from 0.10 to 0.70 weight-percent. In general, the rare-earth oxide additions up to 1.50 weight-percent had little effect on the tensile properties of steel in the cast, wrought and annealed, or wrought and normalized condition. Author

N67-23475* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

SUSTAINED-LOAD TESTS OF PARTIALLY CRACKED 0.220-IN. SOLUTION-TREATED AND AGED Ti-6Al-4V

R. A. Rawe 3 Jan. 1967 14 p refs
(Contract NAS7-101)
(NASA-CR-83076; DAC-59532) CSCL 11F

Sustained-load tests in air and in tap water were performed on solution-treated and aged 0.220-in. Ti-6Al-4V sheet. Specimens were fatigue precracked and loaded in tension to stress levels within 90% of the gross fracture strength as measured in static tests. No failures occurred under sustained load within the test duration (100 hours minimum). Gross fracture strength of specimens subjected to prior sustained loading was 7–18% higher than for specimens not subjected to sustained loads prior to static testing. This increase in gross fracture stress was attributed to room temperature creep during sustained loading. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-21953*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SYNTHETIC ZEOLITES FOR THE PRODUCTION OF CLEAN VACUUM

V. M. Lunev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 422–427 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

In this paper, we describe some experiments which have been staged to determine the absorbing power of zeolites in the range of low pressures (at $T = 77.5°K$) and to explore the possibilities of zeolite application for the production of clean vacuum. Author

N67-22092# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

RADIATION EFFECTS IN BeO

C. G. Collins *In its* High-Temp. Mater. Program 30 Sep. 1966 p 157–169 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

Effects of irradiation on physical properties and microstructure of BeO are summarized. Diffusivity of irradiated BeO, in absence of microcracking, decreases up to about 58% at 300°C and up to about 21% at 1000°C with significant changes for different irradiation temperatures. NSA

N67-22094# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

HIGH-TEMPERATURE RESEARCH ON CARBIDES FOR FUEL AND STRUCTURAL APPLICATIONS

J. F. White and E. F. Juenke *In its* High-Temp. Mater. Program 30 Sep. 1966 p 177–184 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

Reaction products resulting from heating Re and UC at 2000°C were subjected to electron-probe analysis. Details of interface reactions are discussed. Apparatus and techniques for preparing single-phase UC are described. Carbon activity, as a function of composition in the UC region, was determined by the gas–solid equilibration techniques using Re capsules. NSA

N67-22146*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THERMAL CONTROL COATINGS–THERMAL SHOCK EXPERIMENT

In its Radiometry Res. Mar. 1967 21 p (See N67-22141 11-11) CFSTI: HC $3.00/MF $0.65

Results are presented of tests conducted on various spacecraft thermal control coatings. These tests were initiated to investigate physical properties such as adhesion, film integrity, and vacuum/UV/thermal shock resistance. The test set-up and operating procedures are discussed, and the properties of the coatings are described. The test compiled a total of 79-hours of concomittant electromagnetic radiation and 284-hours of cryogenic temp./vacuum, and it is concluded that no loss of adhesion was observed. C.T.C.

N67-22211*# United Aircraft Corp., East Hartford, Conn.

INVESTIGATION OF THE KINETICS OF CRYSTALLIZATION OF MOLTEN BINARY AND TERNARY OXIDE SYSTEMS Quarterly Status Report, Dec. 1, 1966–Feb. 28, 1967

J. F. Bacon 31 Mar. 1967 17 p refs
(Contract NASw-1301)
(NASA-CR-83329; QSR-6) CFSTI: HC $3.00/MF $0.65 CSCL 11B

The essentials of glass formation are being studied by measuring the rate at which crystallization occurs and the degree of control of this rate which can be achieved by nucleating and anti-nucleating agents for such systems as would tend to form complex three-dimensional structures. Research was concentrated on the direct microscopic observation of the crystallization kinetics in two crystal species, cordierite and sapphirine, originating in molten MgO-Al_2O_3-SiO_2 systems. Since this is the first application of this technique to the study, both the experimental procedures followed and the results obtained are given in detail. Viscosity and modulus measurements of newly formulated glass systems, and the mechanical drawing of glass fibers from an orifice are also discussed. A.G.O.

N67-22224# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

ENERGY DISSIPATION OF ELECTRON BEAMS IN MATTER. IV: MEASUREMENT OF ELECTRON ENERGY DISSIPATION IN POLYSTYRENE BY USING IONIZATION CHAMBER

Yohta Nakai, Kohji Matsuda, Toreo Takagaki, and Kiichi Kimura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 8 Oct. 1966 p 7–12 refs (See N67-22223 11-08) CFSTI: HC $3.00/MF $0.65

Spatial distributions of energy dissipation of electrons in polystyrene and carbon were obtained experimentally for

well-collimated electron beams of a few MeV generated from a Van de Graaff accelerator. Experimental data are generally in agreement with the Spencer theory, except for the case of shallow and very deep penetrations as with metallic foils. Discrepancies between experiment and theory could be attributed to neglecting the effects of the secondary electron, as well as electron straggling in the theory. Author

N67-22225# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
THE STUDY OF RADIATION CHEMISTRY BY THE MEASUREMENT OF ELECTRIC CONDUCTIVITY, I
Torao Takagaki, Kanae Hayashi, Koichiro Hayashi, and Seizo Okamura *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 13–24 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

A method is described for the study of ionic species formed in the γ-ray irradiation process that uses electric conductivity measurements. Measurements were made of conductance under and immediately after the irradiation and of ion drift mobilities; and G value for free ion formation and its life time were determined experimentally. Some experiments on cyclohexane in vacuum and oxygen atmosphere were carried out. A marked effect of dissolved oxygen in cyclohexane on anion mobility and decay constant was observed. Author

N67-22226# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
STUDIES OF POLYOXYMETHYLENE. I: SMALL ANGLE X-RAY STUDIES ON POLYOXYMETHYLENE FIBERS
Yasuo Suzuki and Ichiro Sakurada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 25–41 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Delrin and Celcon polyoxymethylene fibers were prepared by the melt spinning technique from the corresponding commercial resins and heating and drawings effects were studied on the small-angle X-ray scattering patterns of the fibers. A discrete diffraction pattern showing the presence of a long period was observed. By heat treatment at 100°C and 150°C in silicon oil at a constant length, the intensity of the discrete diffraction on the meridian and the long period were increased, while the intensity of diffuse scattering on the equator was decreased. As the fibers were drawn, the intensity of diffraction patterns on the meridian of these fibers decreased, the maximum of the discrete diffraction became indistinct and finally disappeared. Author

N67-22227# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
STUDIES ON POLYOXYMETHYLENE. II: SMALL ANGLE X-RAY STUDIES ON POLYOXYMETHYLENE OBTAINED BY RADIATION INDUCED POLYMERIZATION OF TRIOXANE AND FORMALDEHYDE
Yasuo Suzuki and Ichiro Sakurada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 42–47 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Polyoxymethylene samples were prepared by radiation-induced solid phase polymerization of trioxane and liquid phase polymerization of formaldehyde. The solid phase polymerization was carried out in source at 35°, 45° and 55°C, and the liquid phase one at −78°C. Small-angle X-ray scattering was studied. None of these polyoxymethylenes showed a discrete diffraction that indicates the presence of a long period. When these samples were melted and recrystallized by cooling, they exhibited discrete diffraction patterns of ring form. In all cases the long period were 170Å. Author

N67-22228# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
STUDIES ON POLYOXYMETHYLENE. III: RADIATION EFFECTS ON POLOXYMETHYLENE FIBERS
Hasuo Suzuki, Fujiko Kimura, Michiyo Yamaguchi, and Ichiro Sakurada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 48–58 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Delrin and Celcon filament yarns were irradiated with γ-rays of 4.5×10^4 r/hr. at 25°C *in vacuo* and in air to obtain exposure level of $5\times10^5\approx4.3\times10^6$r. The tensile strength and the elongation were considerably decreased with irradiation dose. When the Celcon yarns having a draw ratio of 4.6 were irradiated at 4.3×10^6r *in vacuo*, relative values for the original yarns were 0.5 for tensile strength and 0.4 for elongation, respectively. The lower the draw ratio, the greater the loss of mechanical properties. No serious effect of atmosphere was observed. The values of tensile strength and elongation of the Delrin yarns irradiated at 100°C were found to be somewhat greater than those irradiated at 25°C; and the tensile strength and the elongation of Delrin yarns decreased somewhat more easily than those of Celcon yarns. Although there was no remarkable change in the wide-angle X-ray diagrams between unirradiated and irradiated Delrin yarns, intensities of discrete small angle diffraction on meridian decreased with irradiation. Author

N67-22229# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
RADIATION INDUCED GRAFT POLYMERIZATION TO POLYVINYL CHLORIDE. III: HEAT SHRINKAGE OF ACRYLONITRILE GRAFTED POLYVINYL CHLORIDE FIBER
Toshio Okada and Ichiro Sakurada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 59–69 (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Graft copolymerization of acrylonitrile onto polyvinyl chloride fiber in a stretched state was carried out by a mutual grafting technique with γ-rays, and the heat shrinkage of the grafted fibers was measured. The heat shrinkage of the polyvinyl chloride fiber onto which acrylonitrile was grafted to the extent of about 50% at 60°C decreased compared with the original fiber, and the heat shrinkage was markedly decreased when the grafted fibers had been subjected to heat treatment at 160≈180°C. Author

N67-22230# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
CATALYTIC GRAFT COPOLYMERIZATION ONTO POLYVINYL CHLORIDE
Fujiko Kimura, Keiko Fujiwara, and Ichiro Sakurada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 70–79 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Catalytic graft copolymerizations of vinyl monomers onto polyvinyl chloride powder were carried out in sealed glass ampoules at 60°C *in vacuo* in air. Styrene, acrylonitrile, and vinyl acetate were used as monomers; and the graftings were studied in pure monomers and in monomer solutions. Styrene was grafted most easily, and α,α-azoisobutylonitrile was very effective as a catalyst compared with benzoyl peroxide and potassium persulfate. The grafting rate *in vacuo* was higher than that in air. The grafting of styrene proceeded smoothly without induction period both *in vacuo* and in air, and the graft copolymer could be obtained with good graft efficiency, almost independent of the compositions of the monomer solutions and ratios of monomers to polyvinyl chloride. The presence of methanol in the monomer mixtures was observed to accelerate the grafting. The grafting rate onto fiber was much higher than that onto powder; and for styrene the highest percent grafts observed in the experiments were about 150 for fiber and 60 for powder, respectively. Author

N67-22231# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
EFFECT OF OXYGEN ON RADIATION INDUCED GRAFT COPOLYMERIZATION
Fujiko Kimura and Ichiro Sakurada *In its* Japan. Assoc. for Radiation Res. on Polymers, Vol. 6 Oct. 1966 p 80–88 refs (See N67-22223 11-06) CFSTI: HC $3.00/MF $0.65

Graft copolymerization of styrene onto cotton was carried out in a sealed glass ampoule at room temperature by using Co^{60} γ-rays, with methanol as a solvent, both *in vacuo* and in air. The grafting occurred without an induction period *in vacuo*, while a long induction period was observed in air. For the grafting in air the consumption of oxygen with the irradiation was quantitatively studied by mass spectroscopy. The concentration of oxygen decreased linearly with irradiation dose, and G value for oxygen consumption was found to be about 150. This value is very large compared with that for radical formation. Grafting was markedly retarded when oxygen was present in the system, but after the oxygen was consumed with irradiation, the grafting proceeded at the same grafting rate as observed for grafting *in vacuo*. During the induction period, radicals formed from cellulose, styrene, and methanol reacted preferentially with oxygen molecules to produce some peroxidic compounds. Polymers obtained before the proper grafting took place are considered to be polymeric styrene peroxide. Author

N67-22318# California Univ., Livermore. Lawrence Radiation Lab.
FRICTION AND WEAR OF EXPLOSIVE MATERIALS
K. G. Hoge 1 Sep. 1966 28 p refs
(Contract W-7405-ENG-48)
(UCRL-50134) CFSTI: HC $3.00/MF $0.65

The frictional behavior of various explosive materials, both plastic-bonded and polycrystalline, is discussed. Test data are presented for explosive material sliding on various metallic surfaces and on itself. Surface finishes of 16, 32, and 125 μin. rms were tested. Sliding velocity was varied from 0.001 to 2500 in./min and normal pressure from 125 to about 2500 psi. Of the explosive materials tested, plastic-bonded explosives were found to have a considerably higher coefficient of friction than polycrystalline explosives. The plastic-bonded explosives also showed some viscoelastic or time-dependent effects. Some of the basic theoretical approaches to friction are discussed. Because explosives are generally quite soft, a considerable amount of wear accompanies friction. Therefore, a model for wear was formulated, which accounts for wear during short sliding distances. The contribution of friction and wear to mechanical ignition of explosives was also analyzed. Author (NSA)

N67-22334# California Univ., Livermore. Lawrence Radiation Lab.
THE CREEP BEHAVIOR OF POLYSTYRENE BEAD FOAM UNDER UNIAXIAL COMPRESSION
Maurice Zaslawsky 19 Aug. 1966 49 p refs
(Contract W-7405-ENG-48)
(UCRL-50125) CFSTI: HC $3.00/MF $0.65

The creep behavior of polystyrene bead foam under uniaxial compression was studied in a series of tests. Density of the test specimens ranged from 0.0256 to 0.0534 g/cc, applied stress from 2 to 18 psi, and temperature from 23 to 78°C. With stress and temperature held constant, creep tests were performed for periods ranging from 5 sec to 100 hr. Recovery of some of the specimens after removal of the stress load was measured for an additional 25 hr. Effects of both steady and cyclic stress were studied. Foam density appears to be the most important factor influencing creep rate, while specimen dimensions and surface preparation appear to have little effect. Author (NSA)

N67-22441# Polytechnic Inst. of Brooklyn, N. Y.
THERMODYNAMICS, THERMAL EFFECTS AND DILATATION OF NATURAL RUBBER
Michel Boesl and Frederick Eirich Oct. 1966 210 p refs
(Contract Nonr-839(32)FBM)
(PIBAL-931; AD-644112) CFSTI: HC $3.00/MF $0.65

Of the three different experiments carried out on natural rubber, the force versus temperature measurement have verified that the decay of stress in stretched elastomers is approximately linear with logarithm of time for a considerable period. A viscoelastic mechanism for this decay according to a spectrum of Maxwell terms, can be ruled out as the basis for this form of relaxation because of the nature of the time dependence. As a further difficulty small local defects leading to crack propagation by stress concentration and crystallization of the sample complicate this relatively simple but unexplained form of relaxation. Thus, there is a natural difficulty in the way of determining when the criterion of equilibrium has been adequately fulfilled. In our experiments, the sample was considered fully relaxed when the increment of relaxation over the total span of testing was less than one percent. A new dilatometer was constructed which allows to follow volume changes with stretching. For the first time complications due to swelling could be overcome. Extremely small volume increases were determined during the early exploratory runs, but the dilatometer has to be reconstructed to eliminate metal corrosion. TAB

N67-22701# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART B: CELLULAR PLASTICS
G. Wood Apr. 1964 16 p refs
(RAE-TN-CPM-54) CFSTI: HC $3.00/MF $0.65

This note outlines the useful properties of cellular plastics and recommends temperature limits for service. The cellular plastics considered were thermoplastic rigid foams, thermoset rigid foams, and flexible foams. It was shown that the high strength-to-weight ratio and the low conductivity of cellular plastics make them of great potential value to the aeronautical industry. The most heat resistant, the silicon foams, are among the weakest mechanically and are of limited structural utility. Polyurethane foams are probably the most widely used, but the number of applications could be increased by improvement in the moderate thermal stabilities. Polyurethane or other foams capable of sustaining load and vibration and possessing dimensional stability over long periods at 200° and 300°C would be of great value. N.E.A.

N67-22702# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART 2: STRUCTURAL REINFORCED PLASTICS
G. Wood Feb. 1964 15 p refs
(RAE-TN-CPM-48) CFSTI: HC $3.00/MF $0.65

This note outlines the properties of some commercially available reinforced plastics, paying especial attention to their temperature limitations. Indications of any outstanding advantages or inherent defects of a particular type are also given, together with any notable specific applications. Author

N67-22711# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART 6: ELASTOMERS
G. Wood Apr. 1964 40 p refs
(RAE-TN-CPM-52) CFSTI: HC $3.00/MF $0.65

Elastomers find many applications in aircraft, e.g., seals (static and dynamic), sealants, gaskets, O-rings, and different properties are significant for particular cases. This report reviews the properties of the following more important commercial elastomers and sealants, with emphasis on their temperature limitations: (1) component elastomers—butyl rubbers, acrylics, fluoroacrylates, fluorocarbons, halofluoroelastomers, standard silicone rubbers, nitrile-

silicones, fluorosilicones, and slip rubbers; and (2) sealant elastomers—polysulfides, fluorocarbons, and silicone rubbers. I.v.L.

N67-22716# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART I: GENERAL REVIEW
G. Wood Oct. 1963 22 p
(RAE-TN-CPM-34) CFSTI: HC $3.00/MF $0.65

This note summarizes, for comparative purposes, the temperature limitations of some commercially available polymeric materials grouped into the following eight classes: structural reinforced plastics, dielectrics, fibers, films, elastomers, transparencies, cellular plastics and adhesives. Author

N67-22717# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART 5: FILMS
G. Wood Apr. 1964 12 p refs
(RAE-TN-CPM-51) CFSTI: HC $3.00/MF $0.65

The properties of polymers commonly used for films and coatings are reviewed, and temperature limits for the useful service of these polymers are recommended. The following are discussed: (1) mechanical films; (2) paints—nitrocellulose, acrylics, alkyds, polyurethanes, epoxies, silicones, polyvinyl, chloride, and primers; and (3) coatings—neoprene, polyurethanes, and methoxy methyl nylon. R.T.K.

N67-22782# Royal Aircraft Establishment, Farnborough (England)
TEMPERATURE LIMITATIONS OF POLYMERIC MATERIALS. PART 7: TRANSPARENCIES
G. Wood Apr. 1964 7 p refs
(RAE-TN-CPM-53) CFSTI: HC $3.00/MF $0.65

The temperature limitation of materials presently used in transparencies for aircraft is reviewed. The transparencies discussed are organic glasses—acrylic and polyester; and interlayers—polyvinyl butyral, siloxanes, and castable interlayers. R.T.K.

N67-22890* Aerojet-General Corp., Azusa, Calif.
EVALUATION OF ALTERNATE LUBRICANT/COOLANT FLUIDS FOR SNAP-8
P. I. Wood, J. M. Carter, and F. H. Cassidy 9 Sep. 1965 51 p refs
(NASA-CR-72219; TM-4921-65-1-327) CFSTI: $3.00 CSCL 18J

A study of alternate lubricant/coolant fluids for SNAP-8 was made to update the evaluation which led to the selection of polyphenyl ether (4P3E) some two years prior. Ten candidate fluids were evaluated; of these, the four most promising fluids were compared in as much depth as available data permitted. Properties of the fluids are tabulated in an appendix. Author

N67-23048# Air Force Missile Development Center, Holloman AFB, N. Mex.
EFFECTIVENESS OF NYLON DRAG STRAPS FOR BRAKING MONORAIL SLEDS
Daniel J. Krupovage Nov. 1966 29 p refs
(MDC-TR-66-23; AD-645449) CFSTI: HC $3.00/MF $0.65

Velocity versus coast distance measurements on two monorail rocket sleds were conducted on the Holloman track to obtain numerical information on the braking effectiveness of nylon drag straps. The data were obtained from ribbon frame camera readings and reduced to the form of drag area of the sleds and the drag straps. The straps as described are shown to increase the effective drag area of the monorail sleds used by approximately one square foot and to be an effective means for reducing recovery distance in the speed range below approximately 700 ft/sec. Author (TAB)

N67-23150# Michigan Univ., Ann Arbor. Infrared and Optical Sensor Lab.
BASIC STRUCTURE OF INFRARED GLASSES Final Report, 1 Aug. 1965–31 Dec. 1966
W. C. Levengood and T. S. Vong Jan. 1967 32 p refs
(Contract Nonr-1224(57); ARPA Order 269)
(Rept.-7518-8-F; AD-646243) CFSTI: HC $3.00/MF $0.65

A phenomenological theory, designated herein as the unified glass theory, is presented. The theory introduces the concept of order-disorder transitions and liquid-model transformation within a glass network and was found to be useful in elucidating and predicting structural behavior. The degree of order and the structural characteristics of a glass system were represented by three existing models of liquid structure: Bernal, Stewart, and Frenkel. The unification of these three liquid models constitutes the basis of the proposed theory. Structure-sensitive flaws were utilized extensively in the study to facilitate the formulation of this network hypothesis. The unified glass theory has been applied successfully in categorizing various investigated vitreous systems, among them a nonoxide arsenic trisulfide glass, metaphosphate glasses, and barium silicate infrared systems. Microyield phenomena were critically examined, and the relationships between trace width and flaw number parameter are discussed. A correlation was suggested between the critical stress of defect formation and liquidus temperatures within a field of barium silicate infrared glasses. Author (TAB)

N67-23164# Olin Mathieson Chemical Corp., New Haven, Conn. Polymer Research Section.
DEVELOPMENT OF FLEXIBLE EPOXY RESINS AND COATINGS Final Report, 11 Mar. 1965–31 Dec. 1966
Venkataramaraj S. Urs and Salvatore A. Puglia 31 Dec. 1966 38 p refs
(Contract NOw-65-0321-f)
(AD-645798) CFSTI: HC $3.00/MF $0.65

An epoxide-polyoxypropylene diamine (POPDA-400) cured coating system with improved flexibility, wet adhesion to aluminum substrate, resistance to low (-40F) and high (400F) temperature aging, accelerated weathering and ultra-violet aging over the epoxide-polyamide system was developed for application to Naval aircraft. Polyoxypropylene diamine of molecular weight 490 to 550 (POPDA-400) showed the most promise as a curing agent for the epoxide resins, the cure rate conforming to Contract specifications. Synthesis of POPDA-400 and evaluation of the epoxide-POPDA-400 coating system are described. Author (TAB)

N67-23187# Sandia Corp., Albuquerque, N. Mex.
ENGINEERING STUDY OF THE TENSILE STRENGTH OF FERROELECTRIC CERAMICS
R. H. Dugan Nov. 1966 54 p refs
(Contract AT(-29-1-789)
(SC-DR-66-593) CFSTI: HC $3.00/MF $0.65

A hoop test apparatus for measuring the tensile strength of ceramic materials is described. The use of this apparatus to investigate the effects of grain size on the tensile strength of selected compositions is discussed along with the effects of treatments, such as poling, electroding, and the effects of surface condition on tensile properties. In general, hot pressed materials are stronger than conventionally sintered materials; poling decreases the strength of $PbZrO_3$–$PbTiO_3$ (PZT material) by about 25%; and, the tensile strength of PZT is independent of grain size over the range of about 1 to 15 microns, in contrast to the behavior of typical ceramic materials. Improving the surface finish increased the tensile strength very little while certain heat treatments reduced the strength by nearly 50%. Author (NSA)

N67-23188# California Univ., Berkeley. Lawrence Radiation Lab.
THE EFFECT OF PLASTIC INSTABILITY OF MgO SINGLE CRYSTALS IN COMPRESSION

Donald Riddick Cropper (M.S. Thesis) 2 Sep. 1966 44 p refs
(Contract W-7405-ENG-48)
(UCRL-17105) CFSTI: HC$3.00/MF$0.65

The creep of MgO single crystals loaded in compression was studied under conditions where plastic buckling was likely to occur. The degree of end constraint characteristic of these tests strongly affects the possibility of buckling. Experiments suggest that buckled columns creep at a lower rate than do columns that remain straight. At temperatures around 1300°C and above, the creep rate appears to be particularly sensitive to the nature of the crystal surface prior to deformation. At 1200°C the stress dependence of the creep strain rate can be represented as a power law with a stress exponent of 4.7. This is in reasonable agreement with Chang's theory of creep by diffusion-controlled dissolution of dislocation dipoles and loops. Author (NSA)

N67-23275* Florida State Univ., Tallahassee.
[STUDY OF CRYSTALLIZATION, CROSSLINKING AND DIMENSIONAL CHANGES DURING THE CRYSTAL-LIQUID PHASE TRANSITION OF ORIENTED POLYMERIC SYSTEMS] Semiannual Status Report
Leo Mandelkern 1 Mar. 1967 4 p
(Grant NsG-247-62)
(NASA-CR-83548) CFSTI: HC$3.00/MF$0.65 CSCL 11I

Continuing research on the chemistry involved in radiation crosslinking and on crystallite morphology is briefly described. Manuscripts are mentioned which discuss infrared absorption methods for determining crystalline characteristics of polyethylene and the role of the vinyl end group in causing the more efficient crosslinking in the crystalline state. It is reported that highly oriented and highly crystalline samples of polyethylene samples are being prepared for the study of network properties. N.E.N.

N67-23287*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPRESSIVE BEHAVIOR OF PLATES FABRICATED FROM GLASS FILAMENTS AND EPOXY RESIN
John G. Davis, Jr. and George W. Zender Washington, NASA, Apr. 1967 34 p refs
(NASA-TN-D-3918) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Young's modulus, buckling stress, and maximum strength were determined experimentally for 15 glass-filament reinforced plastic plates of laminated isotropic construction containing either 12 or 18 laminae. Experimentally determined values of Young's modulus and buckling stress are in reasonable agreement with theoretical calculations. The stress–unit-shortening curve for the plates in the post-buckling region can adequately be predicted by conventional theory for metallic plates. However, delamination occurs at loads below the theoretical compressive strength predicted by an effective width formula that is often used to predict the maximum strength of metal plates. In using an effective width formula to predict maximum strength, it was assumed that failure occurs when the edge stress of the buckled plate equals the delamination stress of the unbuckled compression test specimen. On the basis of strength and modulus data obtained in this study, it is shown that the glass–epoxy composite is competitive as a lightweight material with aluminum in applications where plate buckling strength or crushing strength is the design criterion. Author

N67-23378# ARA, Inc., West Covina, Calif.
NONDESTRUCTIVE INSPECTION OF REINFORCED PLASTIC STRUCTURES BY THE NUCLEAR QUADRUPOLE RESONANCE METHOD Final Report, 15 Mar.–1 Nov. 1966
Robert R. Hewitt and Bernard Mazelsky 1 Nov. 1966 52 p refs
(Contract NOw-66-0403-c)
(ARA-77; AD-645562) CFSTI: HC$3.00/MF$0.65

The work reported here is directed toward the investigation of the use of the nuclear quadrupole resonance response of tracer quantities of inert fillers in resins and reinforced polymer structures as a nondestructive testing technique. The strain-sensitive response of nuclear quadrupole resonance has been used to detect defects in idealized test specimens and to measure the strain response of polymer specimens at a microscopic level. The tracer material used in this project was cuprite, Cu_2O, in a reagent grade powder form; the polymer used was Epon 828catalyzed with Versamid 140. Some test specimens were fabricated with the straight resin doped with cuprite, and others were made with a glass laminate reinforced structure of the doped resin. Some glass reinforced specimens were fabricated with defects; these defects were detected by the NQR response. The effect of mechanical degradation, induced by cyclic loading, was also observed in the NQR response. Author (TAB)

N67-23469# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EVALUATION OF FIBROUS MATERIALS IN A CRYOGENIC STRUCTURAL ADHESIVE
L. M. Roseland Nov. 1966 32 p refs
(SM-49202)

The results of a recent cryogenic structural adhesive program are presented and discussed. Twenty-three different fibrous constructions were placed in a urethane/diamine adhesive system and evaluated in T-peel and lap shear over a temperature range from −196°C (−320°F) to 82°C (180°F). One nonwoven glass construction dramatically improves the T-peel strength at all temperatures tested, improves the consistency of results, and produces a uniform thickness bond line. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-21960*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTEGRATION OF CONTROL EQUATIONS AND THE PROBLEM OF SMALL TIME CONSTANTS
J. F. Andrus Washington, NASA, Apr. 1967 42 p
(NASA-TN-D-3907) CFSTI: HC$3.00/MF$0.65 CSCL 12A

A system of first-order linear differential equations with constant coefficients is transformed into a convenient and considerably simplified system of differential equations, referred to as the canonical equations. Alternatively, a transfer function in the form of a rational function is represented by a like system of canonical equations. The latter equations can be readily solved provided the forcing function E_{in} can be conveniently represented. Furthermore, the canonical equations which depend upon poles (eigenvalues) of large magnitude may be discarded when it is evident, as is often the case, that the contributions of their solutions to the response E_{out} of the system are negligibly small. The elimination of such equations enables one to integrate the system numerically with a larger integration step-size than that which would ordinarily be required. Author

N67-22039*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE THEORY AND METHODS OF STATISTICAL INFERENCE
Gerald L. Smith Washington, NASA, Apr. 1967 34 p refs
(NASA-TR-R-251) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Specialized techniques related to statistical inference are presented, and their applications to science and engineering are discussed along with the concepts of probability and optimality. Least squares; maximum likelihood; decision theory and Bayesian estimation; and smoothing, filtering, and prediction are treated in detail. Differences between the various estimation methods are characterized by both the (1) degree of generality in the optimality criterion and (2) completeness of the probabilistic statements about the observation error vector (e) and the state, unknown parameter, or data vector (x). The Bayesian estimation permits the use of any type criterion that can be expressed as a function of the state, utilizes complete descriptions of the prior distributions of e and x, and is the most universally applicable of the statistical inference methods described. M.W.R.

N67-22079*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CALCULATION OF FACTORIALS
M. L. Charnow and Jesse L. Maury, Jr. Sep. 1966 4 p
(NASA-TM-X-55733; X-542-66-460) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A method is described for calculating terms containing products and reciprocals of factorials by using the canonical decomposition of each factor of the factorial, rather than the factorial itself, which reduces the computation of such terms to a few steps involving only addition and subtraction of exponents. Examples are given, and it is concluded that the technique is easy to use and is more rapid than direct calculation. L.E.W.

N67-22096# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik.
LINEAR EIGENVALUE PROBLEMS OF ARBITRARY ORDERS WITH DISSOCIATE BOUNDARY CONDITIONS [LINEARE EIGENWERTPROBLEME BELIEBIGER ORDNUNG MIT ZERFALLENDEN RANDBEDINGUNGEN]
Walter Eberhard Jun. 1964 95 p refs In GERMAN
(JUL-176-MA) CFSTI: HC $3.00/MF $0.65

Estimations derived from the Green function are corrected and an asymptotic representation of the Green function is given. Conditions are derived for the even convergence of the Fourier series with irregular dissociating boundary conditions. It is shown that the function must be regular within a certain even polygon whose corner number is equal to the order of the differential equation and whose size depends on the difference of the number of the boundary conditions with $x=0$ and with $x=1$. Conditions are given for a limited class of boundary value problems which show that the Fourier series of a function converges evenly and represents the function. For the case of dissociating boundary conditions which are regular in the sense of Birkhoff, a general summation for Fourier series is proven and explained by means of a special summation method. Transl. by K.W.

N67-22213*# Alabama Univ. Research Inst., Huntsville.
STUDY OF OPTIMAL AND ADAPTIVE CONTROL THEORY Final Report, May 1964–Jun. 1966
C. D. Johnson Washington, NASA, Apr. 1967 121 p refs
(Contract NAS8-11231)
(NASA-CR-7151) CFSTI: HC $3.00/MF $0.65 CSCL 09C

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N67-22219*# Alabama Univ. Research Inst., Huntsville.
OPTIMAL CONTROL WITH QUADRATIC PERFORMANCE INDEX AND FIXED TERMINAL TIME
C. D. Johnson and J. E. Gibson (Purdue Univ., Lafayette) *In its* Study of Optimal and Adaptive Control Theory Apr. 1967 p 85–102 refs (See N67-22213 11-19) CFSTI: HC $3.00/MF $0.65
(Grant NsG-381)

The conventional solution for the optimal control of a linear stationary regulator with quadratic performance index and fixed terminal time leads to a linear feedback law with time varying gain coefficients. In addition to the usual disadvantages of time variable controllers, these time varying gain coefficients approach infinity as the specified terminal time is approached. It is shown that the optimal control for the above problem can be expressed as a time invariant nonlinear feedback law. Certain parameters in the nonlinear feedback law are functions of the initial time and initial state of the system. The conventional time varying linear feedback law can be obtained directly from the time invariant nonlinear feedback law. The results are applicable to a more general class of optimal control problems involving linear and nonlinear systems. Two examples are given to illustrate the method. Author

N67-22220*# Alabama Univ. Research Inst., Huntsville.
ON A PROBLEM OF LETOV IN OPTIMAL CONTROL
C. D. Johnson and W. M. Wonham (Martin Co., Baltimore) *In its* Study of Optimal and Adaptive Control Theory Apr. 1967 p 105–113 refs (See N67-22213 11-19) CFSTI: HC $3.00/MF $0.65
(Grant NsG-381; NASw-845)

The fixed-time regulator problem with time-invariant feedback control and the unspecified-time regulator problem with bounded control are studied in detail. The linear saturation control law proposed by Letov is found to be correct for only special choices of problem parameters, and further aspects of the solution in the general case are described. The possible existence of a regime of unsaturated nonlinear optimal control is also demonstrated. A.G.O.

N67-22393# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A GENERALIZED BIVARIATE EXPONENTIAL DISTRIBUTION
Albert W. Marshall and Ingram Olkin (Stanford Univ.) Oct. 1966 24 p refs
(D1-82-0572; AD-644120) CFSTI: HC $3.00/MF $0.65

In a previous paper (A Multivariate Exponential Distribution, AD-634 335) the authors have derived a multivariate exponential distribution from points of view designed to indicate the applicability of the distribution. Two of these derivations are based on shock models and one is based on the requirement that residual life is independent of age. The practical importance of the univariate exponential distribution is partially due to the fact that it governs waiting times in a Poisson process. In this paper, the distribution

of joint waiting times in a bivariate Poisson process is investigated. There are several ways to define joint waiting time. Some of these lead to the bivariate exponential distribution previously obtained by the authors, but others lead to a generalization of it. This generalized bivariate exponential distribution is also derived from shock models. The moment generating function and other properties of the distribution are investigated. Author (TAB)

N67-22403# Joint Publications Research Service, Washington, D. C.

THE PRINCIPLE OF THE MAXIMUM IN DIFFERENTIAL GAME THEORY FOR N PLAYERS

G. S. Karvovskiy and A. D. Kuznetsov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 15–19 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

The necessary conditions of optimalness of stratagies in a differential game of *N* players with fixed time are formulated. The linear differential game is investigated for which the algorithm based on the necessary conditions of optimalness solves the problem of synthesis. Author

N67-22405# Joint Publications Research Service, Washington, D. C.

SPECIAL OPTIMIZATION ALGORITHMS FOR THE DISTRIBUTION OF RESOURCES IN OPERATIONS ON PERT CHARTS

V. P. Kondrat'yev *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 37–59 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

The algorithms are discussed which permit, with the help of a computer, realization of optimization of distribution of limited resources with respect to operations on a PERT chart for purposes of achieving the shortest of all possible critical paths, and also the solution of the inverse problem. Author

N67-22406# Joint Publications Research Service, Washington, D. C.

RANDOM SEARCH AND THE GRADIENT METHOD IN OPTIMIZATION PROBLEMS

S. M. Movshovich *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 60–72 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

Two methods of minimization of the function f(x) are investigated: the approximate gradient method and the method of random search. It is shown that for a broad class of functions with identical decrease in f(x) in the gradient method it is required that we determine the values of f(x) at the least number of points. For a narrower class of functions the limiting error in both methods and their rate of convergence are evaluated. Author

N67-22408# Joint Publications Research Service, Washington, D. C.

A QUEUEING SYSTEM WITH INTERVALS OF INACCESSIBILITY

V. V. Kalashnikov *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 81–89 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

An n-channal queueing system is investigated with an unrestricted queue and accessible for calls only at discrete points in time. Formulae are given for the distribution of the length of the queue and the waiting time for beginning of servicing with an exponential distribution of the servicing time and Poisson and quasipoisson flows of calls in the steady-state condition. Author

N67-22409# Joint Publications Research Service, Washington, D. C.

A METHOD FOR DETERMINATION OF THE OPTIMAL DISTRIBUTION OF RELIABILITY AND INDIVIDUAL ELEMENTS OF A SYSTEM

N. N. Kulakov and A. S. Zagoruyko *In its* Tech. Cybernetics, No. 6, 1966 14 Feb. 1967 p 90–101 refs (See N67-22401 11-10) CFSTI: HC $3.00/MF $0.65

A method is proposed for solution of two optimal problems by balancing the sensitivities of the system with respect to individual elements for different cases of increasing their reliability. When the problem cannot be solved exactly by the analytical method, a procedure is proposed for solution by the method of sequential approximation. In the majority of cases for sufficient approximation to the desired result it is sufficient to take no more than three steps. Author

N67-22453# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RANDOM PROCESSES WITH INDEPENDENT INCREMENTS

A. V. Skorokhod 24 Aug. 1966 257 p refs Transl. into ENGLISH of the book "Teoriya Veroyatnostey i Matematicheskaya Statistika" Moscow Izd. Nauka, 1964 278 p

(FTD-TT-66-73; TT-67-60477; AD-645788) CFSTI: HC $3.00/MF $0.65

The book deals with the theory of random process with independent increment—one of the most important branches of random-process theory. This represents the first collection of numerous important results obtained in the study of random processes with independent increments. These results have been scattered through various articles. The book will be of interest both for specialists in probability theory working in the field of random processes, as well as for those studying the theory of random processes and concerned with its applications in various scientific fields. Author (TAB)

N67-22524# Princeton Univ., N. J. Dept. of Engineering.

INTEGRAL REPRESENTATIONS FOR THE DERIVATION OF SAMPLING EXPANSIONS

A. H. Haddad and J. B. Thomas Aug. 1966 53 p refs

(Contract DA-31-124-ARO(D)-292; Grants NSF GK-187; NSF GP-1647)

(TR-17; AROD-5105-16; AD-645933) CFSTI: HC $3.00/MF $0.65

The work presents an integral representation for the derivation of sampling expansions. The representation is based on a property of the resolvent operator on a Hilbert space. The theory of formally self-adjoint differential operators and boundary-value problems is used to obtain a more explicit expression for the integral representation in terms of the Greens function. The principal interest of this representation is the different physical significanes of the permutations possible in performing the integral. Two permutations yield two commonly used methods for the derivation of sampling expansions and offer interesting interpretations in terms of physical systems. The first order differential operator is considered with non-self-adjoint boundary conditions. The representations for this case yield periodically nonuniform and derivative sampling expansions, with corresponding system interpretation. Then the second order differential operator is considered. The general forms of the interpolating functions are found. Examples resulting in nonuniform sampling expansions are discussed. Expansions in Gegenbauer polynomials and Bessel functions are given to illustrate the validity of the method for singular cases as well. Author (TAB)

N67-22593# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE SOLUTION OF A BASIC BIHARMONIC PROBLEM

G. Shafer 27 Jun. 1966 14 p refs Transl. into ENGLISH from Soobschcheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 34, no. 3, 1965 p 527–534
(FTD-TT-65-2004; AD-645820) CFSTI: HC $3.00/MF $0.65

In this work application is given of the new method of solving boundary problems to the first basic biharmonic problem for a simply connected final region. By using the properties of the biharmonic potentials studied by Lauricella, the author constructs some complete systems of functions, and then seeks the solution in the form of a generalized series, in accordance with this system. There is proved the uniform convergence of the series. TAB

N67-22619# Massachusetts Inst. of Tech., Cambridge.
ADEPT—A HEURISTIC PROGRAM FOR PROVING THEOREMS OF GROUP THEORY
Lewis Mark Norton (Ph.D. Thesis) Sep. 1966 181 p refs
(Contract Nonr-4102(01))
(MAC-TR-33; AD-645660) CFSTI: HC $3.00/MF $0.65

A computer program, named ADEPT (A Distinctly Empirical Prover of Theorems), has been written which proves theorems taken from the abstract theory of groups. Its organization is basically heuristic, incorporating many of the techniques of the human mathematician in a natural way. This program has proved almost 100 theorems, as well as serving as a vehicle for testing and evaluating special-purpose heuristics. A detailed description of the program is supplemented by accounts of its performance on a number of theorems, thus providing many insights into the particular problems inherent in the design of a procedure capable of proving a variety of theorems from this domain. Suggestions have been formulated for further efforts along these lines, and comparisons with related work previously reported in the literature have been made. Author (TAB)

N67-22675# Stanford Univ., Calif. Dept. of Mathematics.
DECISION PROCEDURES FOR REAL AND P-ADIC FIELDS
Paul J. Cohen Jan. 1967 37 p refs
(Contract Nonr-225(79))
(TR-2; AD-646005) CFSTI: HC $3.00/MF $0.65

A decision procedure is given for the real number field which reproves a result of Tarski, and for p-adic fields a procedure is given to reduce problems about the field to statements concerning the residue class rings. This gives a purely effective proof of the recent results of Ax and Kochen. The methods used point up the similarity of the two cases. Thus whereas Sturms theorem can be used in the real case, our proof yields an inductive procedure for finding roots in the p-adic case. Finally, the application to Artins conjecture is discussed and it is shown that the exceptional primes are primitive recursive functions of the degree. Author (TAB)

N67-22685# Rutgers Univ., University Park, N. J. Statistics Center.
ON SOME JOINT PROBABILITIES USEFUL IN MIXED ACCEPTANCE SAMPLING
Edward G. Schilling and Harold F. Dodge Dec. 1966 17 p refs
(Contract Nonr-404(18))
(N-26; AD-645560) CFSTI: HC $3.00/MF $0.65

The report presents a method of evaluating certain joint probabilities necessary to determine the operating characteristics of dependent mixed (variables and attributes) sampling inspection plans for the case of single specification limit, known standard deviation, and normal distribution. It also provides a technique for facilitating the computation of these joint probabilities. Author (TAB)

N67-22691# California Univ., Berkeley. Operations Research Center.
A NOTE ON MARKOV-RENEWAL PROGRAMMING
William S. Jewell Nov. 1966 11 p refs
(Contract DA-31-124-ARO(D)331; Grant NSF GP-4593)
(ORC-66-41; AD-645712) CFSTI: HC $3.00/MF $0.65

Various models of Markov-renewal programming were presented in a previous work. Related models have been presented independently by de Cani, Howard, and Schweitzer. Since that time, new results have been obtained which clarify certain questions raised in these papers. Since these results are either in the folklore, or are available only in scattered unpublished reports, it seemed worthwhile to gather them together in one article. This article considers only the finite-state, finite alternative space, infinite-horizon, undiscounted and discounted models previously discussed. Author (TAB)

N67-22703# Royal Aircraft Establishment, Farnborough (England).
A MATRIX FORMULATION FOR THE TIME RESPONSE OF TIME-INVARIANT LINEAR SYSTEMS TO DISCRETE INPUTS
E. Huntley Feb. 1966 59 p ref
(RAE-TR-66038) CFSTI: HC $3.00/MF $0.65

A matrix method is presented for the determination of the time response of time-invariant linear systems to a range of deterministic functions. The factorized transfer function of the system is regarded as representing that of a chain of filters and the input function is assumed to be a linear combination of certain basic functions. The coefficients of these basic functions form an input coefficient vector. The output of the system is shown to be obtainable by successive matrix multiplications of this coefficient vector by response matrices representing the individual filters. The explicit time response of the system is thus produced without resorting to Laplace transform tables. The response matrices for standard filter elements are tabulated for a basic set of commonly occurring input functions. Extensions to non-zero initial conditions and discontinuities in the input functions are included. Author

N67-22738# RAND Corp., Santa Monica, Calif.
REDUCTION OF INTEGER NONLINEAR PROGRAMMING PROBLEMS TO ZERO-ONE LINEAR PROGRAMMING PROBLEMS
Lawrence J. Watters Dec. 1966 8 p refs
(P-3509; AD-645122) CFSTI: HC $3.00/MF $0.65

A nonlinear programming problem is considered in which an effort is made to optimize $f(x_1, x_2, \ldots, x_n)$ subject to $g_i(x_1, x_2, \ldots, x_n) \geq b_i$ $(i = 1, 2, \ldots, m)$, where the variables $x_1, x_2, \ldots, x_n$ assume finite integer values and $f(x_1, x_2, \ldots, x_n)$ and $g_i(x_1, x_2, \ldots, x_n)$ are polynomials. Because of the binary nature of the variables, an appropriate transformation is made that effectively reduces the nonlinear zero–one formulations to equivalent linear zero–one formulations. The application of the transformation to a particular type of investment problem in which the high-risk investment alternatives have non-deterministic interrelated cash flows subject to multiperiod probabilistic budget constraints is shown. A computer program was used to make the necessary transformations and solve the resulting problems with a modified version of the Balas algorithm. R.N.A.

N67-22778*# Colorado Univ., Boulder.
GEOMETRIC THEORY OF OPTIMUM DISORBIT PROBLEMS
A. Busemann and N. X. Vinh Washington, NASA, Apr. 1967 50 p refs
(Grant NGR-06-003-033)
(NASA-CR-750) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This paper presents the general solutions of the problem of optimally disorbiting a vehicle initially in an elliptical orbit. A vehicle is initially moving along an elliptical orbit (E_1) about a spherical planet with center at O. The problem is to bring the vehicle along an optimal trajectory (E_2) (in the sense of minimum fuel consumption) which finally intersects the top of the sensible atmosphere of the central planet. The top of the sensible atmosphere is assumed to form a sphere of radius R and center O, enclosing the planet, and the motion is assumed to be planar. Several sub-classes of the problem are considered, namely when

the entry angle is given, or the entry speed is given or both the entry angle and the entry speed are pre-assigned. Author

N67-22835# Ohio State Univ., Columbus.
EXAMPLES OF SOLUTION ACCURACY IN CERTAIN LARGE SIMULTANEOUS EQUATION SYSTEMS
B. E. Gatewood and Norik Ohanian (North Am. Aviation, Inc., Columbus, Ohio) *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 911-924 refs (See N67-22801 11-32) CFSTI: HC$3.00/MF$0.65

It is demonstrated that for a fixed number of decimal places in the calculations the differential order of the system, the sequencing of the computations, and the relative magnitude of the coefficients are the primary sources of error in the solution of systems of simultaneous equations. Accuracy can be improved by reducing the order of the system, by keeping the multiplying factors small in the computation sequence, and by using realistic coefficients. The extended Choleski method using submatrices is derived and shown to have very little error accumulation in the calculation sequence. As in all methods it is affected by the differential order of the system, losing six places in a beam deflection problem for both 100 fourth order equations and 10,000 second order equations. The transfer matrix method is described and shown to be very accurate for a true order system. It lost four places for 100,000 equations in the beam deflection problem. Methods using forward or back substitution in the original system are shown to have serious error accumulation in the calculation sequence. For certain physical problems these substitution methods must fail regardless of the finite number of places used in the calculations. Author

N67-22953# Technische Hogeschool, Eindhoven (Netherlands).
THE DIFFERENTIAL-DIFFERENCE EQUATION $\alpha XF'(X)+F(X-1)=0$
Jozef Johannes Antonius Beenakker [1964] 121 p
CFSTI: HC$3.00/MF$0.65

An infinite set of analytic solutions are constructed, in which the solutions are linearly independent, and any other solution can be expressed in terms of these by finite or infinite linear combinations. Cases with $\alpha>0$ and $\alpha<0$ are treated separately. Saddle-point analysis is applied to Laplace integrals, and a theorem is presented which states that the sets of solutions of the equation and of the adjoint equation form a biorthogonal system. The Green function is expressed in terms of the functions of the biorthogonal system in the form of an infinite series, and the results is extended in a simple way to arbitrary solutions. The asymptotic properties are discussed, and the theory is applied to a space-filling problem. Author

N67-23045# Boeing Scientific Research Labs., Seattle, Wash.
PATHS ON POLYTOPES: A SURVEY
Victor Klee Nov. 1966 80 p refs *Its* Math. Note 491
(D1-82-0579; AD-644121) CFSTI: HC$3.00/MF$0.65

This report surveys most of the existing knowledge concerning paths or circuits on convex polytopes, and it includes proofs or outlines of proofs for most of the important results in the field. Some of the problems discussed are related to linear programming (estimating the efficiency of various algorithms), to the four-color problem, to a classification scheme for organic compounds (desired, in particular, for efficient encoding of mass spectrograph readings sent from space vehicles) and to the encoding of certain analogue-to-digital conversion systems (used in telemetry for recording angles of displacement). The report is largely expository in nature and takes much of its material from earlier reports or papers by the author and other researchers. However, several new results are also included. In a slightly different form, the material presented will appear as two chapters of Branko Grunbaums book on Convex Polytopes, to be published by John Wiley and Sons in 1966. Author (TAB)

N67-23114# California Univ., Berkeley. Operations Research Center.
RELIABILITY APPLICATIONS OF A BIVARIATE EXPONENTIAL DISTRIBUTION
Robert Harris Dec. 1966 21 p refs
(Contract Nonr-3656(18))
(ORC-66-36; AD-645138) CFSTI: HC$3.00/MF$0.65

The paper examines some two-unit systems in which the lifetimes of the two units in service are not independent but depend upon one another in a particular way. This dependence is characterized by the bivariate exponential distribution of Marshall and Olkin (AD-634 335), which has exponential marginal distributions and other physically motivating properties. Two measures of reliability are determined: the first is the distribution and mean of the time to system failure (i.e., when all units are failed) and the second gives steady-state probabilities of the number of working units. Some graphical results are given to illustrate the deviation of these quantities from the values obtained under the classical assumption of independent lifetimes. Author (TAB)

N67-23285*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A NEW LIE SERIES METHOD FOR THE NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS, WITH AN APPLICATION TO THE RESTRICTED PROBLEM OF THREE BODIES
Siegfried Filippi Washington, NASA, Apr. 1967 39 p refs
(NASA-TN-D-3857) CFSTI: HC$3.00/MF$0.65 CSCL 12A

A new method for the numerical solution of problems in initial value in ordinary differential equations is described. The first step describes the most important theorems of Lie series with reference to the generalized Lie series of Filatov. Then follows a detailed explanation of the new method of Lie series illustrated by the restricted problem of three bodies. For this a number of comparing calculations are made using the power series method and the Runge-Kutta-Fehlberg method. This specific method of Lie series distinguishes itself by being a numerical method of any high truncation error. A simple and efficient automatic step-size control can also be realized. Author

N67-23306*# Arizona Univ., Tucson.
A NEW METHOD FOR TREATING OPTIMAL TRAJECTORIES WITH RESTRICTED SEGMENTS
Thomas L. Vincent and Joseph D. Mason Washington, NASA, Apr. 1967 67 p refs
(Grant NsG-580)
(NASA-CR-744) CFSTI: HC$3.00/MF$0.65 CSCL 22C

A new procedure for handling optimization problems with corners resulting from the imposition of restrictions is presented. The requirements which must be met to apply the methods are that the dynamical equations of constraint contain only one control variable and that these equations can be analytically integrated along any segment of the trajectory in which the control law is restricted. The restricted segments of the optimal trajectory may be effectively eliminated in the process of determining the changes in the Lagrange multipliers, state variables, and Hamiltonian function from one side of the restricted segment to the other. A set of conditions which may be used to determine the changes in the Lagrange multipliers and Hamiltonian are obtained directly from a set of corner conditions developed for trajectories with discontinuities in the state variables. Examples include optimization problems with both first order and second order state variable constraints, optimal staging of a rocket vehicle with coasting periods, and optimal orbit transfer with coasting periods. Author

N67-23407 Joint Publications Research Service, Washington, D. C.
THE MINIMUM PRINCIPLE IN THE CALCULUS OF VARIATIONS

Guido Stampacchia 24 Jan. 1967 21 p refs Transl. into ENGLISH from the Publ. "Atti del Simposio Lagrangiano" Turin, Acad. Sci., 1964 p 1–20
(JPRS-39638; TT-67-30287)

The development of the minimum principle in the theory of elliptic partial differential equations is discussed, with emphasis placed on the evolution of this theory under the influence of variational calculus. A broad outline is made of the stages of this evolution, and the fundamental importance of the physical phenomena interpretation is discussed. C.T.C.

N67-23416# California Univ., Berkeley. Operations Research Center.
DETERMINISTIC SOLUTIONS FOR A CLASS OF CHANCE-CONSTRAINED PROGRAMMING PROBLEMS
Gifford H. Symonds Dec. 1966 32 p refs
(Grant NSF GP-4593)
(ORC-66-34)

The chance-constrained programming problems have the following characteristics: select a deterministic decision vector x to maximize a function Z(x) subject to one or more independent probability constraints of the form $Pr[y(x) \leq 0] \geq \alpha$, where y(x) is a random vector for each given vector x, and α is a given probability. The function Z(x) is continuous, differentiable, and regular enough so that $Z(x) = Z$ at its optimal value, and has no more than a single continuum of points in common with the space of feasible solutions. A certainty equivalent model without random variables is developed for the chance-constrained model such that feasible and optimal solutions of a chance-constrained problem and of its associated certainty equivalent problem coincide. Author

N67-23438# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SOME STRUCTURE THEOREMS FOR L^1 ALGEBRAS, I
Nils Tongring Dec. 1966 17 p refs
(R66SD67)

The classical result that the group ring of a locally compact group is semisimple is extended to the case of vector-valued functions with as general a range as possible. This is accomplished without having to modify the natural definition of the convolution product, and so generalizes the result for the case of a normed algebra as the range. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-21984# Israel Program for Scientific Translations, Ltd., Jerusalem.
INSTRUMENTS AND METHODS FOR METEOROLOGICAL OBSERVATIONS
M. S. Sternzat, ed. 1966 494 p refs Transl. into ENGLISH of the book "Pribory i Metody Nablyudenii" Leningrad, Meteorol. Izd., 1963 Proc. of the All-Union Meteorol. Conf., Vol. IX Published for Commerce Dept. and NSF
(TT-65-50004) CFSTI: HC $3.00/MF $0.65

Conference papers are presented on meteorological measurements, comprehensive automation of meteorological stations, data processing, transducers, measuring methods, and hydrometeorology. For individual titles, see N67-21985 through N67-22038.

N67-21985# Main Geophysical Observatory, Leningrad (USSR).
PRESENT DAY STATE AND TRENDS IN THE DEVELOPMENT OF METEOROLOGICAL OBSERVATIONS AND MEASUREMENTS
D. P. Bespalov and M. S. Sternzat *In its* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 1–5 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The increasing use of meteorological information in various branches of the Soviet economy, such as agriculture, aviation, maritime and railroad transport, and hydraulic engineering, are reviewed in relation to the requirements they impose on measurement techniques and apparatus. It is pointed out that the problem of automation requires more intensive study, due to the steady increase in the number of meteorological elements to be determined, the frequency of measurement, and the numbers of stations and staff. The problem involves methods of increasing the accuracy, reliability, and service life of the instruments; sensor designs; and proper processing, interpretation, and use of the information obtained. The long time lag between design and production, and the introduction of new instruments into stations is mentioned, and the need for better coordination between scientific research and production is stressed. M.G.J.

N67-21986# Central Aerological Observatory (USSR).
THE STATE AND DEVELOPMENT TRENDS OF AEROLOGICAL OBSERVATIONS
P. L. Efimov *In* Israel Program for Sci. Transl., Ltd., Instr. and Methods for Meteorol. Observations 1966 p 6–10 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The development of the radio sounding station network since 1940 is reviewed, and the technical improvements which were incorporated into the system are assessed. Improved types of radiosondes and ground-based radar stations, which increase the quality of aerological observations, are discussed. Methods of temperature and rawin sounding of the atmosphere, and of atmospheric sounding from high speed jet planes are reported. Also considered are the methods developed for evaluating the accuracy of meteorological measurements, and the automatic processing and transmission of sounding station data to synoptic stations. M.G.J.

N67-21987# Main Geophysical Observatory, Leningrad (USSR).
COMPREHENSIVE AUTOMATION OF THE HYDROMETEOROLOGICAL STATION NETWORK
V. P. Petrov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 1–5 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The establishment of automatic telemetering meteorological stations (ATMS), and their importance for the comprehensive automation of the hydrometeorological service (CAHS), are discussed. The ATMS is intended to replace the existing nonautomatic stations, and to ensure automation of all processes carried out at existing stations. The ATMS is defined as an electronic computing device with automatic feeding, processing and printing of meteorological data by means of a teletypewriter. Tabulated data are presented to show that the capacity of an ATMS for transmitting meteorological parameters to be measured is $I \approx 160$ binary digits. Analytical data on existing network operations are given; these data serve as a basis for the structural scheme of the ATMS and for the system of comprehensive automation. Major problem areas are identified as the design of suitable telemetering devices, the development of automatic instrument blocks; and improved means of telecommunication. Alternative ways for developing the CAHS are assessed. M.G.J.

N67-21994# Central Aerological Observatory (USSR).
EXPERIENCE IN PROCESSING AEROLOGICAL DATA WITH ELECTRONIC COMPUTERS

M. V. Krechmer and G. A. Smirnov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 70–79 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Consideration is given to the problem of devising an algorithm and program for primary aerological data conversion in a computing center, and to the methods for testing the correctness of computer operation. The selection of mathematical schemes for the performance of various operations, and illustrations of their practical use are discussed. These include (1) primary processing involving the immediate rejection of a priori recognized wrong data from subsequent analysis; averaging of meteorological elements; determination of pressure curve; approximation of temperature and humidity curves; and calculation of height and search for particular temperature and humidity points. The computer operation program for processing the derived algorithm consists of 21 units. Control signals are mostly transmitted successively from one unit to the other. The duration of full data processing from one radiosonde launching is 150 seconds. Tests, used to check the accuracy of computer operation, are calculated on keyboard digital computers in units that mostly coincide with the program units. M.G.J.

N67-21996# Scientific Research Inst. of Hydrometeorological Instruments (USSR).

THE USE OF RADIOISOTOPES IN HYDROMETEOROLOGICAL RESEARCH AND MEASUREMENTS

A. I. Danilin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 87–94 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Data are presented to show that the use of gamma rays in snow cover investigations permits accurate determination of the water equivalent of snow and the dynamics of its storage and melting, without interfering with the natural occurrence of the snow cover. The use of cobalt 60 and of cesium 137 as radiation sources is discussed. The development of a portable gamma ray snow gauge and an automatic radioactive snow gauge is reported. The use of gamma radiation to determine soil moisture and water regime in soils is reviewed, and the advantages of the technique are cited. Other applications are listed as measurements of evaporation from soil surfaces, solid river load, discharge of water and solid load, and the density of herbage. M.G.J.

N67-21997# All Union Scientific Research Inst. of Hydroengineering and Land Reclamation (USSR).

SOIL MOISTURE MEASUREMENTS WITH NEUTRON FLUX

L. I. Beskin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 95–101 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Several types of neutron devices equipped with various slow neutron detectors were developed and tested. Some were calibrated specially for hydrologic determinations and use was made of 1.5, 2, and 3-inch access tubes reinforced by special casing tubes. Data are presented on the sensitivity of the probes with respect to the moisture content variation and intensity of slow neutron flux with a 10^5 neutron/sec source and a 20% soil moisture content. Based on these results, it is concluded: (1) The probe with boron detector and frontal location of the radiation source has the highest sensitivity for moisture content up to 30% and a linear calibration curve with lateral location of the source. (2) Cadium-shielded detectors have sufficient sensitivity for moisture measurements. (3) The probe with scintillation detectors for slow neutrons has good sensitivity and high efficiency, which can be further increased by using a luminophor enriched with B^{10}. (4) The epithermal neutron scintillation detector has low sensitivity. (5) The accuracy of neutron moisture probes varies over a wide range but is not inferior to the conventional gravimetric sample method, and is simpler to use. M.G.J.

N67-21998# Main Geophysical Observatory, Leningrad (USSR).

METHODS FOR THE MEASUREMENT OF TEMPERATURE AND HEAT FLOW IN SOIL

D. P. Bespalov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 102–109 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The problems involving heat flow measurements in soil are discussed, and the errors inherent in calculation methods are examined. The growing acceptance of heat flow meters is noted, and the importance of obtaining the relationship between the heat flow in the soil and the heat flow through the plate of the meter is stressed. To permit a more rigorous determination of the dependence of the conversion coefficient on the sizes of the meter and on the heat conductivity of the medium, an equation is derived for heat propagation in a homogeneous medium in which a body is inserted with a heat conductivity differing from the conductivity of the medium. Several examples are given to show the relative agreement between heat flow measurements in soil, and calculations. Details are also given on a device for the remote measurement of soil temperature distribution at various depths; the set-up consists of 10 resistance thermometers and a measuring bridge. M.G.J.

N67-22000# Scientific Research Inst. of Hydrometeorological Instruments (USSR).

ACHIEVEMENTS IN RADIO SOUNDING AND IN THE DESIGN OF NETWORK RADIOSONDES

V. A. Usol'tsev and K. N. Manuilov *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 116–119 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Improved versions of the code type radiosonde were developed to permit more accurate measurements of temperature, pressure, and humidity. A characteristic feature of these sondes is the almost total absence of errors due to friction in the mechanism. As the transducers operate under small loads, it was possible to design extremely reliable sensors. One model uses a special coding drum which, while rotating, periodically touches with its conducting surface the pointers controlled by the sensing elements. Each position of the pointer with respect to the coding drum corresponds to a particular combination of the radio transmitter circuit closures in the form of Morse code. An essential element of the radiosonde is identified as the semicylindrical coding drum, with the code signs engraved on the grooved surface by photochemical techniques. Other innovations are the special electric motor introduced to eliminate the dependence of drum speed on altitude, and for operation at low temperatures without lubrication; and an automatic recorder. M.G.J.

N67-22001# Central Aerological Observatory (USSR).

ACCURACY OF TEMPERATURE-WIND SOUNDING OF THE ATMOSPHERE

O. V. Marfenko *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 120–125 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The nature and cause of random errors in two radiosondes (A-22-III and RKZ-1) were studied. The scatter in the readings of sondes of the same conditions was taken as the random error; random errors were determined by comparing simultaneous readings of several sondes of the same type launched from the same carrier. Tabulated data are presented on the root mean square errors of measuring with each model. It was concluded that the A-22-III radiosonde ensures higher accuracy for altitudes up to 20 km. However, the point is made that its accuracy can be increased by improving the design, reducing the radiation component of measuring errors, increasing the rigidity of the device, and improving the manufacturing process. M.G.J.

N67-22003# Central Aerological Observatory (USSR).

INTERPRETATION OF DATA RECORDED BY A MEASURING DEVICE MOVING AT HIGH SPEED IN UPPER AIR LAYERS

A. I. Repnev *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 134–141 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

The factors causing the measured air pressure, density, and composition to differ from the true values of these parameters in the upper atmosphere are examined. The kinetic theory of gases was used as a basis for the solutions, with the method adopted typical of the theory of free molecular flow. Based on the expressions derived, solutions are proposed to the problems of (1) the relationship between pressure and density as measured within the sampling volume of the device and in the atmosphere; (2) density gradient within the device; (3) the effect of the accommodation coefficient; (4) recombination of atoms in the device; (5) mass selection; and (6) the measurement of atmospheric temperature by the effusion method. M.G.J.

N67-22004# Main Geophysical Observatory, Leningrad (USSR).
AEROLOGICAL DATA REQUIREMENTS FOR NUMERICAL ANALYSIS AND FORECASTING

L. S. Gandin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 142–148 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Optimum locations of network stations and maximum permissible distance between them were analyzed for economic effectiveness of meteorological data gathering. Statistical interpolation methods obtained the particular meteorological elements over the center of a triangle formed by the network stations. Considered were deviations of the element from its normal value, the determination error for a given station, the distance between stations, and the normalized correlation function of the element. Obtained distances between the stations and the root-mean-square error in measuring the given element were depicted graphically for a geopotential height of 500 Mb isobaric surface. For wind calculations, the wind vector was integrated from the underlying surface to a given level of an atmosphere layer. G.G.

N67-22006# Main Geophysical Observatory, Leningrad (USSR).
THE POSSIBILITY OF MEASURING PRECIPITATION OVER THE OCEAN BY THE USE OF RADAR

G. I. Shkoda *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 158–165 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Analyzed are various methods to increase the accuracy of radar precipitation measurements over an ocean by exact determination of radar reflectivity from a volume precipitation target. Special calculations on the measuring accuracy under consideration of microwave energy loss due to attenuation by distance and attenuation caused by precipitation showed that highly efficient radar stations operating in the 5 cm$\leq\lambda\leq$ 10 cm band ensure a rather accurate determination of precipitation intensities at correct selection of wavelength. It was concluded that approximate determination of precipitation over an area of several hundreds of kilometers can be obtained at proper wavelength and radar equipment selection. G.G.

N67-22011# Main Geophysical Observatory, Leningrad (USSR).
MEASUREMENT AND CONTROL OF AIR HUMIDITY BY THE DEW POINT METHOD

N. P. Fateev *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 207–216 refs (See N67-1984 11-20) CFSTI: HC $3.00/MF $0.65

The characteristics of improved humidity meters with semiconducting thermoelements for transducers are described. Each of the designs has a sensing element-mirror with built-in wire-resistance microthermometers; semiconductor thermocouple microcooler with current-intensity control; a dew indicator; a dew point measuring element; and a storage battery or rectifier for power supply. Galvanic dew indicators are utilized in stationary hygrometers where the electrode is shortened to the surface of the mirror by means of condensed water droplets or ice; automatic hygrometers use a photoelectric dew indicator with current control to feed the thermocouple and a magnetic amplifier for current regulation. A bridge unbalance signal feeds the phase detector and thus initiates the control signal. The polarity of the latter depends on the magnitude of the initial level of condensate on the mirror to which the instrument has been adjusted. This automatic hydrometer type is suitable for field measurements and as airborne equipment. G.G.

N67-22018# Main Geophysical Observatory, Leningrad (USSR).
CONTRIBUTION TO THE THEORY OF OPTICAL METHODS OF ATMOSPHERIC AEROSOL INVESTIGATION

K. S. Shifrin and V. F. Raskin *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 266–273 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

A beam of monochromatic light was used to study the distribution of suspended solid and liquid particles in the atmosphere. Light scattered while interacting with the aerosol particles, and light passing through them was observed for its angular scatter dispersion characteristics, as well as by data on spectral transparency of aerosol volume, and polarization characteristics. Scattering indices and dispersion coefficients were then analyzed to determine the microstructure of the aerosols. A gamma distribution formula describing the dispersion coefficient of an individual particle was used to obtain the curve of spectral aerosol transparency and to deduct formulas for size distribution of atmospheric aerosol particles. G.G.

N67-22032# Main Geophysical Observatory, Leningrad (USSR).
IMPROVED METHODS FOR PRIMARY PROCESSING OF METEOROLOGICAL DATA

I. A. Berlin, E. Kh. Burkovskaya and A. M. Tsyganova *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods, for Meteorol. Observations 1966 p 373–379 refs (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Means of improving the primary processing of meteorological data are discussed in terms of saving time and providing more accuracy. Design of coding forms for key punching results of observations are considered necessary, as is the revision of the existing meteorological logbooks to reduce the number of intermediate records that are kept. The use of punched cards for the mechanical production of all tabulated data is suggested, as is the use of a punch-card file for the editing and publishing of these observations. Studies are required of the distribution regularities of individual weather characteristics, and their correlation with overall meteorological data. Methods suggested for the critical analysis of primary data include comparing observations made (1) at one station over a long period of time, (2) individual meteorological events from several stations, and (3) individual characteristics of the same meteorological element. M.W.R.

N67-22037# Main Geophysical Observatory, Leningrad (USSR).
SOME PROBLEMS CONCERNING METHODS OF METEOROLOGICAL OBSERVATION IN THE ANTARCTIC ZONE, AND INTERPRETATION OF OBSERVATION RESULTS

I. V. Vorob'ev, L. V. Dol'ganov, I. D. Kopanev, S. A. Smirnov, and L. F. Shkolysr *In* Israel Program for Sci. Transl., Ltd. Instr. and Methods for Meteorol. Observations 1966 p 408–413 (See N67-21984 11-20) CFSTI: HC $3.00/MF $0.65

Methods are summarized for the processing of meteorological data obtained during the Soviet Antarctic expeditions. Air pressure, air temperature, humidity, wind, and cloudiness measurements are reviewed; and mention is made of various actinometric units and their limitations. Methods currently in use for processing these data are mentioned; and note is made of the need for further refinements, with specific allowance for conditions found in the Antarctic. M.W.R.

N67-22295# Woods Hole Oceanographic Institution, Mass.
ARUBA EXPEDITION 1965—OBSERVATIONS AND ANALYSIS Final Report, Feb.–Mar. 1965
E. B. Kraus, Jason Ching, and Russell Elsberry Dec. 1966 168 p refs *Its* Reference No. 66–70
(Grant NSF GP-4711) CFSTI: $3.00/MF $0.65

CONTENTS:

1. ARUBA EXPEDITION 1965—OBSERVATIONS AND ANALYSIS E. B. Kraus p 5–9 refs (See N67-22296 11-20)
2. RECORDS OF DOUBLE THEODOLITE BALLOON ASCENTS p 10–38
3. A COMPARATIVE STUDY OF STRESS, WING, AND WAVE DEVELOPMENT AT DIFFERENT DISTANCES FROM A LEE SHORE, PART I J. Ching p 39–145 refs (See N67-22297 11-20)
4. ANALYSIS OF AIRCRAFT OBSERVATIONS IN AND BELOW THE TRADE WIND INVERSION OVER ARUBA R. Elsberry p 146–162 refs (See N67-22298 11-20)

N67-22296# Woods Hole Oceanographic Institution, Mass.
ARUBA EXPEDITION 1965—OBSERVATIONS AND ANALYSIS
E. B. Kraus *In its* Aruba Expedition 1965—Observations and Analysis Dec. 1966 p 5–9 refs (See N67-22295 11-20) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-SC-90784; Grants NSF GP-317; NSF GP-4711)

An outline of observations and data analysis is presented for an expedition to the island of Aruba, Netherlands Antilles, during 1965 to study air–sea interaction processes around a flat island across the direction of the trade winds. The specific purpose was to examine the effect of sea surface conditions and of a small flat island on the vertical flux of heat and momentum across the lower boundary of the atmosphere. Meteorological expeditions are briefly described. S.P.

N67-22297# Woods Hole Oceanographic Institution, Mass.
A COMPARATIVE STUDY OF STRESS, WIND, AND WAVE DEVELOPMENT AT DIFFERENT DISTANCES FROM A LEE SHORE, PART I
Jason Ching *In its* Aruba Expedition 1965—Observations and Analysis Dec. 1966 p 39–145 refs (See N67-22295 11-20) CFSTI: HC $3.00/MF $0.65

Field observations, and tabulated data on wind speed, spectral estimates, and stress measurements are presented for the Aruba expeditions. Studies were made to determine how the stress and air flow vary with fetch when the water surface has evolved in response to the air flow. The data is of importance in wave and weather forecasts and also in studies relating to ocean currents and energy budgets over a water surface. Results indicate a marked dependence of drag on the fetch; in particular, there appears to be significant relationship with the larger lower frequency waves. Results of the wind program indicate that the stress over water increases with increasing fetch, valid at least up to 1200 yards. The stress depends on both the velocity and the local wave spectrum under the condition of a neutrally stratified air flow. The roughness length is a function of the friction velocity. S.P.

N67-22298# Woods Hole Oceanographic Institution, Mass.
ANALYSIS OF AIRCRAFT OBSERVATIONS IN AND BELOW THE TRADE WIND INVERSION OVER ARUBA
Russell Elsberry *In its* Aruba Expedition 1965—Observations and Analysis Dec. 1966 p 146–163 refs (See N67-22295 11-20) CFSTI: HC $3.00/MF $0.65

Results of aircraft missions to study the presence of gravity waves and the vertical intrusion of moist air into the trade wind layer as it flows across the island of Aruba are examined. The picture of the flow across the northern tip of Aruba is as follows. The potential temperature distribution of the trade wind air below the inversion is not significantly changed by sensible heat transfer. The only change in potential temperature distribution with height up to 1600 meters is that due to the shifting of the inversion height. A large vertical flux of moisture is accomplished by convective motion in the region of the island. The moisture distribution appeared to return to the dry upstream condition within a few miles leeward of the island. A wave-like vertical motion is initiated in the flow upstream of the island and is gradually damped out as the air flows over the island. The moisture maximum above the inversion occurs by the entrainment of moist air from within the inversion layer when the inversion is displaced downward. S.P.

N67-22437*# Volt Technical Corp., Washington, D. C.
PRACTICAL UTILIZATION OF DATA OF METEOROLOGICAL SATELLITES
K. Ya. Kondrat'yev, E. P. Borisenkov, and A. A. Morozkin Greenbelt, Md., NASA Goddard Space Flight Center, 14 Feb. 1967 10 p Transl. into ENGLISH from the book "Prakticheskoye Ispol'zovaniye Dannykh Meteorologicheskikh Sputnikov" Moscow, Gidrometeoizdat., 1966
(Contract NAS5-12487)
(NASA-CR-83393; TTC-AM-10563) CFSTI: HC $3.00/MF $0.65 CSCL 04B

The table of contents and photograph figure captions are presented for a book on the practical interpretation, analysis, and utilization of cloud and radiation observations for the earth's meteorological satellites. C.T.C.

N67-22570# Travelers Research Center, Inc., Hartford, Conn.
RELATIONSHIPS BETWEEN TROPICAL PRECIPITATION AND KINEMATIC CLOUD MODELS Semiannual Report, 1 May–31 Oct. 1966
Geirmundur Arnason and Alexander F. Saunders Dec. 1966 53 p refs
(Contract DA-28-043-AMC-02192(E))
(ECOM-01219-1; SAR-1; Rept.-7482; AD-645888) CFSTI: HC $3.00/MF $0.65

The report gives the results of the third and most advanced experiment in a series of numerical experiments on convection. Convection is initiated by means of a buoyant bubble near the lower boundary of a two-dimensional model, and the equations of motion, continuity, thermodynamics, and cloud physics are solved numerically. The results show the bubble to rise at an accelerated rate, become saturated, and gradually turn into a precipitating cloud. Because of the complexity of the model and the resulting computer program, the experiment was restricted to eight minutes of convection simulating the early stages of development. The pressure field associated with the convection is of special interest; it differs greatly from its hydrostatic counterpart and is instrumental in maintaining a downdraft outside the cloud boundary. In the updraft, the vertical pressure force opposes the buoyancy force and may become comparable in magnitude with the negative buoyancy of the liquid water. The bulk effects of the microphysics of cloud and precipitation incorporated into the convection model include autoconversion of cloud to precipitation, depletion of cloud by falling precipitation (accretion), and evaporation of precipitation falling through unsaturated air. Author (TAB)

N67-22584# Joint Publications Research Service, Washington, D. C.
SOVIET SCIENTISTS PRESENT PAPERS ON SATELLITE METEOROLOGY
19 Jan. 1967 49 p refs Transl. into ENGLISH from Tr. Mirovogo Meteorol. Tsentra. Vopr. Sputnikovoy Meteorol. (Leningrad), no. 8, 1965 p 45–67, 76–86
(JPRS-39599; TT-67-30248) CFSTI: HC $3.00/MF $0.65

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1. INTERPRETATION OF THE MESOSTRUCTURE OF CLOUDINESS N. F. Vel'tischev p 1–15 refs (See N67-22595 11-20)

2. CHANGES IN TEMPERATURE AND GEOPOTENTIAL RESULTING FROM HEAT RADIATION INFLUX P. N. Belov and A. F. Kivganov p 16–32 (See N67-22596 11-20)

3. THE POSSIBILITY OF THE METEOROLOGICAL INTERPRETATION OF LONGWAVE RADIATION Yu. V. Kurilova p 33–43 refs (See N67-22597 11-20)

N67-22595# Joint Publications Research Service, Washington, D. C.

INTERPRETATION OF THE MESOSTRUCTURE OF CLOUDINESS

N. F. Vel'tischev *In its* Soviet Scientists Present Papers on Satellite Meteorology 19 Jan. 1967 p 1–15 refs (See N67-22594 11-20) CFSTI: HC $3.00/MF $0.65

A study was conducted on the rise of waves in the atmosphere, without consideration of the effect of the underlying surface. The relation existing between the wavelength and certain parameters of air flow and atmospheric stratification is determined and analyzed. The statistical links between the individual parameters characterizing air flow and the characteristics of the mesostructure of cloudiness are also determined. Author

N67-22596# Joint Publications Research Service, Washington, D. C.

CHANGES IN TEMPERATURE AND GEOPOTENTIAL RESULTING FROM HEAT RADIATION INFLUX

P. N. Belov and A. F. Kivganov *In its* Soviet Scientists Present Papers on Satellite Meteorology 19 Jan. 1967 p 16–32 (See N67-22594 11-20) CFSTI: HC $3.00/MF $0.65

A method is presented for computing long- and shortwave radiation fluxes and radiation-induced changes in temperature and geopotential. The practical realization of this method on electronic computers is discussed. The results of computations for various synoptic situations are described and analyzed. Author

N67-22597# Joint Publications Research Service, Washington, D. C.

THE POSSIBILITY OF THE METEOROLOGICAL INTERPRETATION OF LONGWAVE RADIATION

Yu. V. Kurilova *In its* Soviet Scientists Present Papers on Satellite Meteorology 19 Jan. 1967 p 33–43 refs (See N67-22594 11-20) CFSTI: HC $3.00/MF $0.65

Excerpts are presented on methods of obtaining values for outgoing radiation from radiosonde data. Results of estimating the individual terms of the energy balance equation are also assessed. Tabulated data show the components of the energy balance equation for an atmospheric column with unit cross section (10^{10} erg/cm^2-day). As an aid in analyzing the relationship between the various forms of energy and the effective radiation at the 100 mb surface, more than 50 computed cases are summarized. The concept of free potential energy is introduced in order to delineate that portion of the total potential energy which can be associated with the effective fluxes of long wave radiation. M.G.J.

N67-22601 Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 363

27 Jan. 1967 92 p refs Transl. into ENGLISH From Ch'i Hsiang Hsueh Pao (Peking), v. 35, no. 3, Aug. 1965 p 265–272, 280–292, 333–337, 343–351, 357–370 (JPRS-39684; TT-67-30333) CFSTI: $3.00

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1. ICE AND SNOW CRYSTALS IN PRECIPITATION COLD STRATUS OF KIRIN AREA FROM APRIL THROUGH JUNE 1963 K.-f. Sun and L.-K. Yu. p 1–12 refs (See N67-22602 11-20)

2. A PRECIPITATION TEST IN SEEDING OF CONGESTUS CUMULUS WITH SALINE POWER IN HUNAN IN THE SUMMER 1963 P.-m. Ma, I.-m. Sun, J.-h. Chao, and F.-p. Hsueh p 13–35 refs (See N67-22603 11-20)

3. THE DISTRIBUTION OF THE MEAN SQUARE DEVIATION OF THE MEAN-MONTHLY ALTITUDE AT 500 MILLIBARS ON THE EURASIAN CONTINENT AND ITS APPLICATION IN LONG RANGE FORECASTING K.-c. Hsu p 36–44 refs (See N67-22604 11-20)

4. AN EXPERIMENT ON THE QUANTITATIVE DESCRIPTION OF CLIMATIC ELEMENT FIELDS BY ORTHOGONAL FUNCTIONS Y.-n. Shih p 45–57 refs (See N67-22605 11-20)

5. A FOUR LEVEL BAROCLINIC MODEL OF THE STEADY PERTURBATIONS IN THE WESTERIES S.-c. Ch'en p 58–69 refs (See N67-22606 11-20)

6. THE VORTICITY BUDGET OF THE ZONE OF SUBTROPICAL HIGHS IN THE NORTHERN HEMISPHERE FOR WINTER C.-s. Ch'en and P.-t. Lin p 70–83 refs (See N67-22607 11-20)

N67-22602 Joint Publications Research Service, Washington, D. C.

ICE AND SNOW CRYSTALS IN PRECIPITATION COLD STRATUS OF KIRIN AREA FROM APRIL THROUGH JUNE 1963

K'o-fu Sun and Lai-Kuang Yu *In its* Transl. on Communist China's Sci. and Technol., No. 363 27 Jan. 1967 p 1–12 refs (See N67-22601 11-20) CFSTI: $3.00

Aluminum-foil sampling apparatus was used to observe ice and snow crystals in clouds; altogether 432 different samples were collected. This data is used in this paper to study the general characteristics of ice and snow crystals in precipitant cold stratus drawing the following conclusions: (1) The mean concentration of ice crystals (0.1–0.3 mm) in clouds is 26.2 particles per liter; the mean concentration of snow crystals (mean diameter at 1 mm) is 0.18 particle per liter. (2) The distribution frequency is comparatively concentrated, mostly within 200% of the mean value. (3) The mean situation of ice and snow crystals in the cloud is closely related to the temperature of cloud decks and altitude; the lower the temperature of the cloud deck, the higher is the mean concentration of the ice and snow crystals in the clouds. Author

N67-22603 Joint Publications Research Service, Washington, D. C.

A PRECIPITATION TEST IN SEEDING OF CONGESTUS CUMULUS WITH SALINE POWDER IN HUNAN IN THE SUMMER 1963

P'ei-min Ma, I-min Sun, Jui-hua Chao, and Fan-ping Hsueh *In its* Transl. on on Communist China's Sci. and Technol., No. 363 27 Jan. 1967 p 13–35 refs (See N67-22601 11-20) CFSTI: $3.00

This paper analyzes macrographic and microscopic observation data in a test of artificial precipitation in Hunan Province in 1963. In addition, statistics are compiled for some of the macrographic data of 1959 through 1962. Generally, after catalysis by use of saline powder, the concentration of large drops in congestus cumulus increased, and its spectrum also widened. The reaction corresponds to the concentration of the spreading saline nuclei. The ascending airflow is intensified and the water content is also increased; the ascension of a cloud deck was very obvious. The increase in intensity and the duration of precipitation at ground level are also correspondingly affected. Typical examples illustrate the effect of catalysis of congestus cumulus with saline powder. Moreover, the formation of precipitation by seeding of saline

powder and the effect of air currents in clouds are discussed. The authors consider that under advantageous conditions an adequate artificial seeding method can be used to increase the precipitation of warm congestus cumulus. Author

N67-22604 Joint Publications Research Service, Washington, D. C.

THE DISTRIBUTION OF THE MEAN SQUARE DEVIATION OF THE MEAN-MONTHLY ALTITUDE AT 500 MILLIBARS ON THE EURASIAN CONTINENT AND ITS APPLICATION IN LONG RANGE FORECASTING

Kuo-ch'ang Hsu *In its* Transl. on Communist China's Sci. and Technol., No. 363 27 Jan. 1967 p 36-44 refs (See N67-22601 11-20) CFSTI: $3.00

The data from 1951 to 1962 was used to make a distribution diagram of the mean square deviation of the mean-monthly altitude of 500 millibars (mb) of the various months of the Eurasian Continent; in addition, the distribution characteristics of the divergence center of the mean-monthly altitude of 500 mbs of the Eurasian continent were analyzed. According to the theory of binomials, some problems are discussed in a general investigation index method. Moreover, the anomalous altitude data of the divergence center were used to conduct an experiment of general investigation of the index which obtained good results. Author

N67-22605 Joint Publications Research Service, Washington, D. C.

AN EXPERIMENT ON THE QUANTITATIVE DESCRIPTION OF CLIMATIC ELEMENT FIELDS BY ORTHOGONAL FUNCTIONS

Yung-nien Shih *In its* Transl. on Communist China's Sci. and Technol., No. 363 27 Jan. 1967 p 45-57 refs (See N67-22601 11-20) CFSTI: $3.00

In this paper the author proposes the problem of the quantitative description of the climatic element field by means of approximate analytic expression. It is felt that the application of the linear combination of the orthogonal function in approximate expression has many advantages. A formula to measure the precision of the calculation is also proposed. Two calculated examples are given for obtaining the coefficients of the various items in the linear combination; the quantitative descriptive equation expressed by the linear combination, the related index of the descriptive equation relative to the original data, the standard error, and variance ratio. Moreover, from the contribution of the related indexes of the various items of coefficients, the relative importance of the various items are compared. Author

N67-22606 Joint Publications Research Service, Washington, D. C.

A FOUR LEVEL BAROCLINIC MODEL OF THE STEADY PERTURBATIONS IN THE WESTERIES

Shou-Chun Ch'en *In its* Transl. on Communist China's Sci. and Technol., No. 363 27Jan. 1967 p 58-69 refs (See N67-22601 11-20) CFSTI: $3.00

The steady perturbations in the westeries are analyzed by means of a four-level baroclinic model. It is shown that the intensity of steady perturbations with wave number 1-2 caused by topography increases upward in the stratosphere during winter, and decreases upward in summer. Author

N67-22607 Joint Publications Research Service, Washington, D. C.

THE VORTICITY BUDGET OF THE ZONE OF SUBTROPICAL HIGHS IN THE NORTHERN HEMISPHERE FOR WINTER

Ch'iu-Shih Ch'en and Pan-ta Lin *In its* Transl. on Communist China's Sci. and Technol., No. 363 27 Jan. 1967 p 70-83 refs (See N67-22601 11-20) CFSTI: $3.00

In this paper, the maintenance of the subtropical high in the northern hemisphere for winter is discussed by means of the balance equation of the vorticity. The calculated results show that the divergence of the vorticity transfer due to large-scale eddies is the dominant factor for maintaining anticyclonic vorticity in the region near 30°N. The anticyclonic vorticity due to this divergence process occurs mainly in the upper troposphere; at the same time, the transfer to earth rotation vorticity may effect the anticyclonic vorticity downward to the lower troposphere. The maintenance of the westerly jet is also discussed from the viewpoint of the vorticity transfer. The northward vorticity transfer by large-scale eddies reaches its maximum value over 45°N, so that it may play an important role both for the maintenance of the mean zonal westerlies and its jet in the middle latitude. Over 30°N, however, the vorticity transfer by large-scale eddies vanishes, and on the contrary, both the transfer of earth rotation vorticity and of the relative vorticity have larger value. Author

N67-22610# National Engineering Science Co., Pasadena, Calif.

ON WIND TIDES AND LONGSHORE CURRENTS OVER THE CONTINENTAL SHELF DUE TO WINDS BLOWING AT AN ANGLE TO THE COAST

Charles L. Bretschneider Dec. 1966 66 p refs

(Contract Nonr-4177(00))

(SN-134-13; AD-645703) CFSTI: HC$3.00/MF$0.65

This paper begins with the usual equations of hydrodynamical motion in two dimensions. Certain assumptions are then made which lead to a direct analytical solution. One of the assumptions made is that the net transport shoreward is insignificant compared with the longshore transport, and in effect the net transport shoreward becomes zero under steady state conditions. Other assumptions made are that the rate of precipitation impact is negligible, the water surface slope parallel to the coastline is negligible, and that the higher order differentials along the coastline are much smaller than the corresponding counterparts directed perpendicular to the coastline. Finally, it is assumed that the bottom friction factor to be used with the longshore current can be approximated by use of n in Mannings equation. The special case of a continental shelf, bottom of constant slope, is treated in detail, although it is shown that the same principles can be applied to composite bottom profile, representing a bottom of variable slope. TAB

N67-22640# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.

INVESTIGATIONS OF THE THERMALLY STRATIFIED BOUNDARY LAYER

E. J. Plate and C. W. Lin Feb. 1966 55 p refs *Its* Paper No. 5

(Grants DA-AMC-28-043-64-G-9; DA-AMC-28-043-65-G20)

(AD-645531) CFSTI: HC$3.00/MF$0.65

The problem of modeling a thermally stratified boundary layer of the atmosphere in a wind tunnel is investigated. The modeling of the mean-velocity distribution is based on the validity of the semi-empirical, logarithmic-linear formula proposed by Monin and Obukhov; this equation is shown to be in good agreement with the experimental data of this study. In addition, a method is given to permit the determination of the scaling length parameter L for the logarithmic-linear distribution from a knowledge of the gross parameters of the mean flow. This method is based on results which were obtained in previous investigations of the heat transfer from smooth, flat plates. The parameter L, which is defined by this method, yields the best fit between wind tunnel data and logarithmic-linear distribution with the same numerical coefficients as those determined by others for the atmospheric surface layer. Author (TAB)

N67-22778* Honeywell, Inc., Minneapolis, Minn.
THE ANALYSIS OF 15μ INFRARED HORIZON RADIANCE PROFILE VARIATIONS OVER A RANGE OF METEOROLOGICAL, GEOGRAPHICAL, AND SEASONAL CONDITIONS
John R. Thomas, Ennis E. Jones, Robert O'B. Carpenter, and George Ohring (Geophys. Corp. of Am., Minneapolis, Minn.) Washington, NASA, Apr. 1967 323 p refs
(Contract NAS1-6010)
(NASA-CR-725) CFSTI: $3.00 CSCL 04B

A statistical approach and two curve fitting approaches were used to determine significant variations in the complete horizon-radiance profile caused by variations in geographical, temporal, and meteorological conditions. In the profiles statistics studies, the expected systematic behavior of the complete profile with season and latitude was observed. In addition, the nearly linear variation of radiance (at a given tangent height) with temperature at the 10mb altitude was obtained. The curve fitting approaches resulted in equations capable of achieving accuracies of from 2% to 6% in calculating radiance profiles with a possibility of obtaining 1% accuracy with additional effort. C.L.W.

N67-22900# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA-V Monthly Graphs, Jan.–Dec. 1966
J. F. Steljes Jan. 1967 77 p
(CRGP-1253; AECL-2664) CFSTI: HC $3.00/MF $0.65

Uncorrected and barometer-corrected results from the cosmic ray neutron monitoring stations in Canada are given in tabular form for September through December 1966. Normalized graphs are given for January 1966 through December 1966. A spurious annual variation is noted. Author

N67-23133# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex.
EASTERN TEST RANGE REFERENCE ATMOSPHERE FOR ASCENSION ISLAND, SOUTH ATLANTIC, PART I
Jul. 1966 90 p refs
(IRIG, 104-63, Pt. I; AD-645591) CFSTI: HC $3.00/MF $0.65

The document contains an explanation of the basic data, computational procedures, and the resulting values tabulated for altitude intervals between mean sea level and 30 km altitude. Monthly and annual thermodynamic values and wind quantities are tabulated. The thermodynamic quantities are height (gpm), pressure (kgf/sq m), pressure (mb), temperature (K), virtual temperature (K), density (g/cu m), speed of sound (m/sec), relative humidity (%), and vapor pressure (mb) tabulated at 250 m intervals of geometric altitude. The wind quantities are scalar wind and zonal and meridional component values (m/sec) for eleven cumulative percentage frequency levels tabulated at 1 km intervals from 0 to 27 or 30 km altitude. TAB

N67-23146# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
METEOROLOGICAL ASPECTS OF CONSTANT-LEVEL BALLOON OPERATIONS IN THE SOUTHWESTERN UNITED STATES
Bernard D. Gildernberg 48 p *Its* Surv. in Geophys. No. 187
(AFCRL-66-706; AD-644895) CFSTI: HC $3.00/MF $0.65

Important meteorological parameters are discussed in detail and related to operational factors. Objective and subjective information and procedures are given for forecasting surface and in-flight weather, balloon trajectories, and other pertinent meteorological phenomena. The role of the meteorologist during all phases of a balloon operation is described. Author (TAB)

N67-23161# Massachusetts Inst. of Tech., Cambridge
APPLICATION OF RADAR TO MEASUREMENT OF SURFACE PRECIPITATION Annual Report, 1 Sep. 1965–31 Aug. 1966
Pauline M. Austin Ft. Monmouth, N. J., Army Electron. Command, Dec. 1966 17 p
(Contract DA-28-043-AMC-01472(E))
(RCS-OSD-1366; ECM-01472-2; AD-645733) CFSTI: HC $3.00/MF $0.65

Instrumentation: The major undertaking in instrumentation has been the installation of two new radars on the roof of the Green Building, which houses the Center for Earth Sciences at MIT. This task is now practically complete. A digital delay-line sweep integrator has been designed and built, and is ready for use with the new 10 cm radar. Observations: Radar data were taken in 40 storms during the past year, mostly summer thunderstorms. Drop size samples and radar-rain gauge comparison measurements were obtained on only four days. Application and Analysis: In the study of mesoscale precipitation patterns and their relation to macroscale parameters, all storms for 1962 and 1963 have been classified according to synoptic type. Mesoscale patterns as depicted by the rain gauge network have been analyzed for each group. A numerical model for the evolution of a snowflake spectrum has been set up and computations carried as far as is feasible by hand. Results show quite good agreement with observed snowflake spectra. Author (TAB)

N67-23174# Weather Wing (1st), San Francisco, Calif. 96525
TAIWAN LOW STUDY
Aug. 1966 37 p refs *Its* Tech. Study 1
(AD-645087) CFSTI: HC $3.00/MF $0.65

The report discusses the various aspects of Taiwan Low developments and movements. The climatology of the Taiwan area during the northeast monsoon, a general description of Taiwan Lows, and a review of several forecast studies and associated weather are given. Various rules of thumb connected with the Lows are also presented. Author (TAB)

N67-23175# Weather Wing (1st)., San Francisco, Calif. 96525
THE PROBLEMS OF FOG AND STRATUS FORECASTING AT MISAWA AB, JAPAN
George Taniguchi Sep. 1966 21 p *Its* Tech. Study 2
(AD-645088) CFSTI: HC $3.00/MF $0.65

The study describes the physical nature of summertime fog and stratus phenomenon at Misawa Air Base, Japan; its frequency of occurrence, and the forecasting problems involved. All known forecast techniques and their effectiveness are reviewed. Author (TAB)

N67-23304*# Honeywell, Inc., Minneapolis, Minn.
THE SYNTHESIS OF 15μ INFRARED HORIZON RADIANCE PROFILES FROM METEOROLOGICAL DATA INPUTS
Jerry C. Bates, David S. Hanson, Fred B. House, Robert O'B. Carpenter (GCA Corp.), and John C. Gille (Florida State Univ.) Washington, NASA, Apr. 1967 307 p refs
(Contract NAS1-6010)
(NASA-CR-724) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Infrared radiance emitted by the earth and atmosphere varies spectrally and with tangent height depending on the absorbing properties of the atmospheric gases and on the temperature and pressure distribution with altitude. This study was conducted to develop a computational program for modeling the horizon radiance profile for the 15μ carbon dioxide absorption band using temperature and pressure profiles as inputs. This effort included the specification and development of the theoretical considerations, selection of basic data sources, and the determination of the necessary spectral resolution and range of integration in the 15μ band. Significant contributions to the theory of modeling horizon

radiance profiles include improved carbon dioxide transmittance data determined from all available sources, quantitative evaluation of the effects of Doppler broadening and absence of local thermodynamic equilibrium, and a quantitative description of the effects of clouds when observed in this spectral region. A description of the computational model, as well as the many specific analyses conducted using it, is included. Author

N67-23375# Illinois State Water Survey, Urbana.
INVESTIGATION OF THE QUANTITATIVE DETERMINATION OF POINT AND AREAL PRECIPITATION BY RADAR ECHO MEASUREMENTS Final Report, 1 Oct. 1964–30 Sep. 1966 1964–30 Sep. 1966
E. A. Mueller and A. L. Sims Dec. 1966 118 p refs
(Contract DA-28-043-AMC-00032(E))
(ECOM-00032-F; AD-645218) CFSTI: HC $3.00/MF $0.65

A review of work accomplished on this contract is presented including references to the appropriate interim reports for details. The limiting accuracy for radar estimation of rainfall rate is determined to be plus or minus 40 percent. The location of the medium range raingage network is shown along with the amount of data collected thus far. No results from this network are available at present. A Doctoral thesis entitled, Radar Cross Sections from Drop Size Spectra, is included as an Appendix. Author (TAB)

N67-23417# International Geophysical Year World Data Center A, Asheville, N. C.
METEOROLOGICAL ROCKET NETWORK FIRINGS, VOLUME III, NO. 7 Data Report
Jul. 1966 199 p
GPO: $3.00

The wind and temperature measurements from all available meteorological sounding rocket firings are presented for July, 1966, along with computed values for pressure, density, and the speed of sound. The data is presented in tabular form and includes the local radiosonde observations nearest the time of firing. C.T.C.

N67-23444# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
STATISTICAL AND DYNAMICAL ANALYSES OF SEVERE STORMS Final Report, 1 Oct. 1965–30 Sep. 1966
Yoshikazu Sasaki and John M. Lewis Feb. 1967 34 p
(Grant WBG-72)
(ARL-1523-2) CFSTI: HC $3.00/MF $0.65

A mathematical model of severe storms and a statistical analysis of wind are presented. The mathematical model is developed on the basis of relationships between the three-dimensional structure and horizontal movement of convective systems. Axial asymmetry of the systems along the vertical axes at the centers of systems and influences of boundary layer on the structure and movement are the most important factors of the model. Wind records were analyzed for a non-storm situation, and topographic effects on the meso-network data were studied. The horizontal wind fluctuations were analyzed for their spectral content over a three-hour period. Figures illustrate the Fourier analysis of the topography. Results show an apparent relationship between frequency content of wind records and the wavelength content of terrain over which wind traveled. That is, the amplitude fluctuation in the wind record at a given station appears to be inversely related to the topographic fluctuation upstream of the network station. S.P.

N67-23447# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
STRUCTURE AND MOTION OF CONVECTIVE SYSTEMS UNDER INFLUENCES OF BOUNDARY LAYER
Yoshikazu Sasaki 1966 27 p refs
(Grants WBG-72; NSF GS-238)
(ARL-1523-1) CFSTI: HC $3.00/MF $0.65

Relationships between the three-dimensional structure and horizontal movement of convective systems are investigated on a theoretical basis, and a mathematical model of storms is developed. Axial asymmetry of the systems along the vertical axes at the centers of systems and influences of boundary layer on the structure and movement are the most important factors of the model. For simplicity, latent heat release is simulated by a negative static stability and the viscosity terms of the boundary layer are approximated by a simple form of surface friction. The model is illustrated on the basis of solutions of linearized equations. The solutions show significant differences on the structures between the cases: one with small or no movement of systems but with influences of boundary layer, and the other with movement of the system and with no or negligible magnitude of viscosity of the boundary layer. The former, the boundary layer case, shows a harmonic solution of vertical patterns of all variables and the latter shows an exponential solution. The orientations of azimuthal patterns of both geopotential ϕ and temperature θ are significantly different between the above two cases. The time variation of the variables is exponential in the former case and oscillatory in the latter case. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-21983*# IIT Research Inst., Chicago, Ill.
ERROR ANALYSIS OF CELESTIAL-INERTIAL NAVIGATION FOR LOW-THRUST INTERPLANETARY VEHICLES
Alan L. Friedlander Washington, NASA, Apr. 1967 86 p refs
(Contract NAS2-3348)
(NASA-CR-740) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Navigation during planetocentric maneuvers of interplanetary missions is treated in an error analysis of celestial-inertial navigation for low thrust electrically propelled space vehicles. For the planetocentric phases, or the escape and spiral capture phases, trajectory characteristics and navigation performance at low altitudes are discussed. Numerical results are included from the computer program for earth escape from navigation initiated from a 50,000 km near-circular orbit. Mention is made of Mars and Venus orbiter missions and Mars and Jupiter flybys. The effect of incorrect assumptions in the *a priori* statistical covariance is detailed. An attempt was made to assign reasonable characteristics and numerical values to the assumed error model; or, when this was not possible, to investigate the error model sensitivity by parameter variations. It is concluded that onboard celestial-inertial navigation using optimal state estimation techniques will offer the necessary high performance required for interplanetary missions. M.W.R.

N67-22178* Honeywell, Inc., Minneapolis, Minn.
INFRARED HORIZON DEFINITION A State-of-the-Art Report
Raymond J. Kirk, Bruce F. Watson, Edward M. Brooks, and Robert O'B. Carpenter (GCA Corp.) Apr. 1967 259 p refs
(Contract NAS1-6010)
(NASA-CR-722) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The present knowledge and theories of the earth's radiance characteristics, techniques for analysis of radiance profile variations, and performance of radiance detector equipment were examined. Meteorology, atmospheric physics, and horizon profile modeling and synthesis were analyzed. Special atmospheric conditions which could cause variations in the 15 micron horizon profile, including concentration variations of water vapor, ozone, carbon dioxide cloud conditions, and thermal variations, are described in detail.

Theoretical horizon radiance profiles were synthesized from basic meteorological factors and the work was examined as it relates to computing horizon radiance profiles from atmospheric temperature profiles. Varying transmissivity data, atmospheric refraction, Doppler broadening, and absence of local thermodynamic equilibrium were also examined. Variations in the profiles as a function of temperature, clouds, atmospheric circulations, spatial and temporal parameters, and wavelengths were also assessed. Data from the Irate, X-15, D-81, Kodak, Tiros, and Nimbus programs were analyzed, along with several balloon radiance measurement programs. Author

N67-22485# Royal Aircraft Establishment, Farnborough (England).
DETERMINATION OF GAS FLOW PARAMETERS FROM PROPANE ATTITUDE CONTROL JETS, AND THEIR EFFECT ON SATELLITE OPTICAL SENSORS AND TELESCOPES
A. E. Smith and T. J. Punter Sep. 1966 71 p refs
(RAE-TR-66290)

Parameters of the gas flow from a 5 gm thrust propane attitude control jet are determined and physical condition of the exhaust gas in a satellite's environment are investigated. Theoretical investigations show that the propane gas has negligible effect on the attitude sensing systems of a satellite, or on the optical systems of projected scientific experiments in a satellite. Author (ESRO)

N67-22494# European Space Vehicle Launcher Development Organization, Paris (France).
CLOSED LOOP SIMULATION OF OPTIMUM GUIDANCE OF SPACE VEHICLES BY MEANS OF ANALOGUE COMPUTER TECHNIQUES
R. Cosaert and E. Gottzein (Bolkow Entwicklungen K. G.) *In its* ELDO Tech. Rev., Vol. I, No. 3 1966 p 191–231 refs (See N67-22491 11-31) CFSTI: HC $3.00/MF $0.65

Analog computers are the usual medium for simulating the dynamic behavior of a missile, while trajectory calculation and guidance law evaluation are normally done on digital computers. In this report, an analog method for simulating the movement of the center of gravity and three methods for simulating optimum guidance laws by parallel or sequential analog techniques are described. Author (ESRO)

N67-22809# Queens Univ., Belfast (Northern Ireland).
SIMULATION OF GROUND CONTROLLED APPROACHES WITH REFERENCE TO CERTAIN ACCIDENTS
K. J. Holden Aeronautical Res. Council, Feb. 1963 50 p refs Supersedes ARC-24545; see X64-10525
(ARC-CP-748; ARC-24545) CFSTI: HC $3.00/MF $0.65

Two accidents are described, in which two aircraft build up long-period expanding oscillations about the glide path. This motion is then investigated by simulation techniques, and its causes determined. The trouble is found to be inherent in the technique of using the throttle to control height and the elevator to control speed. This is demonstrated by systematic use of the throttle in response to height errors, according to various logical schemes. It is found that, in certain circumstances, entirely logical use of the throttle results in an oscillation of increasing amplitude no matter how successfully the pilot controls speed with the elevators. It is concluded that accidents have sometimes resulted from use of the throttle to control height. Author

N67-23048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRONIC AIDS TO AIRCRAFT NAVIGATION
G. P. Astaf'yev, V. S. Shebshayevich, and Yu. A. Yurkov 30 Jun. 1966 352 p refs Transl. into ENGLISH from the book "Radiotekhnicheskiye Sredstva Navigatsii Letatel'nykh Apparatov" Moscow, Izd. Sovet. Ratio, 1962 p 126–204, 356–437, 458–530, 573–602, 725–823, and 867–941
(FTD-MT-65-94; TT-67-60475; AD-645773) CFSTI: HC $3.00/MF $0.65

Contents: Amplitude radionavigational devices and systems; Frequency-sensitive radio navigational devices and systems; Time-sensitive radio navigation devices and systems; Combination radio navigational systems; Complexing radiotechnical aids to navigation for aircraft. TAB

N67-23061*# Illinois Univ., Urbana. Coordinated Science Lab.
PASSIVE DAMPING OF THE GENERAL RELATIVITY SATELLITE GYRO
T. C. Chen, J. Hsu, and D. Skaperdas Nov. 1966 33 p refs
(Grant NsG-443; Contract DA-28-043-AMC-00073(E))
(NASA-CR-83569; R-330; AD-644725) CSCL 17G

A passive damping method for aligning the instantaneous spin, symmetry and angular momentum axes of a solid, axially symmetric almost spherical satellite gyro is analyzed. Damping is accomplished by the dissipation of energy due to cyclic strains in the gyro body caused by its torque-free precession. Damping is calculated for a particular gyro design. Author (TAB)

N67-23139# Woods Hole Oceanographic Institution, Mass.
EXPERIMENTAL VLF RELATIVE NAVIGATION ON R/V ATLANTIS II, CRUISE 15
J. H. Stanbrough, Jr. Nov. 1966 47 p refs *Its* Reference No. 66-61
(Contract Nonr-3351(00); Grant NSF G-821)
(AD-646056) CFSTI: HC $3.00/MF $0.65

An experimental long-range relative navigation system was employed on the Research Vessel ATLANTIS II of the Woods Hole Oceanographic Institution during Cruise 8 to the Indian Ocean in 1963 and Cruise 15 which circumnavigated the globe in 1965. The very low frequencies (VLF) transmitted by stations having stabilized carriers (a few parts in 1011) can be received throughout the world. Navigational information is obtained from the comparison of the received signals of two or more stations with a precision oscillator which may be computed to longitude and latitude if the starting point is known; thus, the system is relative. Reference points could be supplied to the VLF system from a satellite radio navigator that was loaned by the U.S. Navy for this cruise. Best positioning agreed to within 1-3 nautical miles from best ships position under favorable conditions. The VLF equipment also was able to provide (1) a measure of ships drift on station, (2) precise time and frequencies, and (3) a means for calibrating the ships EM log at sea. Author (TAB)

N67-23262*# General Dynamics/Convair, San Diego, Calif.
CENTAUR AC-8 POSTFLIGHT GUIDANCE ANALYSIS
J. Greenstein, L. Ojeda, R. Wagar, and M. Winkler 1 Jul. 1966 80 p
(Contract NAS3-8701)
(NASA-CR-83536; GD/C-BTD66-072) CFSTI: HC $3.00/MF $0.65 CSCL 17G

An analysis, based on telemetered digital computer and pulse data, of the guidance equations and guidance hardware is presented. All of the first-burn and coast guidance objectives are reported fulfilled, but the second MES was not successful because of H_2O_2 depletion. Among the results of the analysis are: (1) flawless guidance computer operation until the end of telemetry coverage; (2) smaller velocity errors, including both tracker and guidance system, than on previous flights; (3) small accelerometer bias errors and a 7-arc-second platform pitch error; (4) a close alignment of vehicle thrust vector with the velocity-to-be-gained

vector, and good attitude control and yaw steering; (5) fewer different limit cycles of accelerometer than on previous flights; (6) good analog guidance data except for an unexplained shift of 0.9 deg/hr on the w component of gyro torquing; and (7) standard deviation of calibration shifts well within specification. N.E.N.

N67-23476*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala

ON THE CALCULATION OF AN INERTIAL NAVIGATION SYSTEM

N. Ya. Vovchenko Redstone Arsenal, Ala., Redstone Sci. Inform. Center, Dec. 1966 13 p refs Transl. into ENGLISH from Russian Jointly supported by Army Missile Command

(NASA-TM-X-59482; RSIC-621) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A refinement of previously derived dynamics equations for the calculation of a geometrical inertial navigation system is presented. The operation of the system during motion of an object in a great circle relative to the earth is considered. An estimate is made of the methodological errors due to translational and Coriolis accelerations. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-22067*# Oak Ridge National Lab., Tenn.

A PROGRAM FOR CALCULATING OPTIMUM DIMENSIONS OF ALPHA RADIOISOTOPE CAPSULES EXPOSED TO VARYING STRESS AND TEMPERATURE

J. P. Nichols and D. R. Winkler Apr. 1967 76 p refs Sponsored by NASA

(Contract W-7405-ENG-26)

(NASA-CR-72172; ORNL-TM-1735) CFSTI: HC $3.00/MF $0.65 CSCL 18B

A method and computer program were developed for calculating the creep and optimizing the dimensions of capsules filled with alpha-emitting radioisotopes. The method solves an integral equation that was developed assuming linear accumulation of partial creep lives and relating life to time-dependent stress and temperature. The computer program, Capsul, is written in Fortran language for the IBM 360/75 computer. The program makes a least squares fit of the creep life function using conventional constant stress, constant temperature creep data. Dimensions of capsules having maximum thermal power per unit of weight, volume, or area are calculated for a given creep life and pressure-temperature history using a numerical Lagrange multiplier formulation. The program also calculates the life to a prescribed strain for capsules of given dimensions and pressure-temperature history. The method has been used to analyze creep data for the alloys 304 stainless steel, Hastelloy N, Nb-1% Zr, FS-85, and T-222. Author

N67-22081# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

HIGH-TEMPERATURE MATERIALS PROGRAM

30 Sep. 1966 192 p refs

(Contract AT(40-1)-2847)

(GEMP-61; PR-61) CFSTI: HC $ 3.00/MF $0.65

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12. ADVANCED PRESSURE VESSEL MATERIALS F. C. Robertshaw p 141–142

13. PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 IN POTENTIAL MELTDOWN ENVIRONMENTS J. F. White p 143–155 refs (See N67-22091 11-06)

14. RADIATION EFFECTS IN BeO C. G. Collins p 157–169 refs (See N67-22092 11–18)

15. HIGH-TEMPERATURE THERMOCOUPLE AND ELECTRICAL MATERIALS RESEARCH E. S. Funston and W. C. Kuhlman p 171–176 refs (See N67-22093 11–22)

16. HIGH-TEMPERATURE RESEARCH ON CARBIDES FOR FUEL AND STRUCTURAL APPLICATIONS J. F. White and E. F. Juenke p 177–184 refs (See N67-22094 11-18)

N67-22082# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operations.

HIGH-TEMPERATURE REACTOR MATERIALS RESEARCH

J. B. Conway and P. N. Flagella *In its* High-Temp. Mater. Program 30 Sep. 1966 p 17–31 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

Creep-rupture tests were made on Mo–Re–W alloys and on arc-cast Mo and W sheets. Effect of alloy composition on ductility and creep resistance at 1600° and 2200°C for various stress levels was determined. NSA

N67-22083# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

RADIATION EFFECTS ON FAST REACTOR CLADDING AND STRUCTURAL MATERIALS

J. Moteff and F. Kingsbury *In its* High-Temp. Mater. Program 30 Sep. 1966 p 33–53 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

Radiation effects on the physical properties of recrystallized W rods and on Mo–Re–W alloys are reported. Ductility of the irradiated materials decreased but tensile strength increased. Annealing at 1100 to 1200°C restored ductility of the W and similar treatment at 451 to 690°C restored that of the alloy. Hot hardness measurements were made on fast neutron irradiated W

single crystals and on polycrystalline specimens of Mo, Re–W, Mo–Re–W, Mo–Ti–Zr, and Mo–Re alloys. Electromicroscopic structure studies revealed no fundamental differences between irradiated, irradiated and annealed, and unirradiated materials. NSA

N67-22085# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
FISSION PRODUCT TRANSPORT PROCESSES IN REFRACTORY-METAL FUEL SYSTEMS
P. K. Conn *In its* High-Temp. Mater. Program 30 Sep. 1966 p 79–91 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

Experiments on diffusion of krypton-85 in refractory metals are described. Diffusion coefficients increase with decreasing concentration, concentration gradient, and increasing distance of penetration. It is indicated that permeation of ^{85}Kr through Re, Ta, and W either does not occur or occurs at undetectably slow rates at 2300 to 2400°C. A computer program was devised to permit quantitative determination of individual isotopic components of composite gamma ray spectra and the study of fission product migration in refractory metals. NSA

N67-22086# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
OXIDATION-RESISTANT FUEL ELEMENT MATERIALS RESEARCH
J. F. Collins and H. R. Stephan *In its* High-Temp. Mater. Program 30 Sep. 1966 p 93–103 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

Details of development and evaluation of oxidation-resistant fuel elements for gas-cooled reactors are reported. Fundamental advances were made in the areas of fuel element stability, iron-base and chromium-base cladding alloys, and fission product retention under high burnup conditions. Nondestructive analytical procedures for quantitative measurement of surface U concentration were developed. NSA

N67-22088# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
ADVANCED LONG-LIFE REACTOR FUEL CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT
J. F. Collins and F. C. Robertshaw *In its* High-Temp. Mater. Program 30 Sep. 1966 p 111–117 ref (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

As part of a research program to develop fuel cladding and structures for fast breeder reactors, diffusion-strengthened Al–Cr–Fe-base alloys were studied. The alloy was prepared in powder form by atomization from the molten state, compacted and hot extruded into solid form. The alloy was found to remain essentially stable with respect to hardness and microstructure after aging for periods up to 100 hours at 450 to 1100°C. Oxidation resistance was comparable to that of the melted and wrought alloy. NSA

N67-22093# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
HIGH-TEMPERATURE THERMOCOUPLE AND ELECTRICAL MATERIALS RESEARCH
E. S. Funston and W. C. Kuhlman *In its* High-Temp. Mater. Program 30 Sep. 1966 p 171–176 refs (See N67-22081 11-22) CFSTI: HC $3.00/MF $0.65

The thermoelectric properties of Mo–49 at. % Ru were investigated in the development of high-temperature thermocouples, electrical, and electronic materials for high-temperature reactors. Sensitivity of the Mo–Ru alloy, when used with a positive thermoelement of Mo–1 at. % Ru, is 6.3 microvolts °C at 1400°C. Thermoelectric output signal of a W–5 Re/W–25 wt % Re thermocouple decreased because of nuclear transmutations after 6 months exposure to thermal neutron flux, causing the true temperature to be higher than the temperature predicted from the calibration curve for an unirradiated W–5 Re/W–25 Re thermocouple. NSA

N67-22304# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
THE RESTRICTED RELEASE OF PLUTONIUM
D. C. Hunt 17 Oct. 1966 69 p refs
(Contract AT(29-1)-1106)
(RFP-799) CFSTI: HC $3.00/MF $0.65

A study was made of the possible hazard outside an enclosure due to the uncontrolled oxidation of plutonium within the enclosure. Data on the existent observational restricted plutonium release are reviewed and a release model was constructed relating the free release source strength and the parameters describing the release. The method of analysis is to postulate a set of accidents in which the release variables are individually maximized. The accident that the model indicates as having the greatest release potential is taken as the maximum credible accident. The method is used to evaluate the leakage limits of the critical mass assembly cell of the Rocky Flats Plant Nuclear Safety Facility. The results generally indicate that restricted release is unlikely to lead to dangerous air-borne plutonium concentrations and specifically show the Rocky Flats Plant Assembly Cell leakage limits are conservative by several orders of magnitude. Author (NSA)

N67-22305# Argonne National Lab., Ill.
THE ROLE OF THE ADJOINT FLUX IN DETERMINING REACTOR STABILITY
Richard Harry Jason (Ph.D. Thesis—Purdue Univ.) Mar. 1966 95 p refs
(Contract W-31-109-ENG-38)
(ANL-7189) CFSTI: HC $3.00/MF $0.65

The conditions required for the boundedness and stability of the output of a reactor system for the situation in which the reactor properties are explicit functions of space and power level are determined. This nonlinear problem was investigated by using the methods of time-dependent perturbation theory as applied in quantum mechanics. A condition on the perturbation matrix was found which is sufficient to insure boundedness in the large of the neutron flux and reaction rates such as power density. This condition yields to equivalent conditions on the adjoint flux. Since the latter obeys a linear equation, it is simpler to study its behavior as an indicator of the boundedness of the reactor system. The reactor system is described by a one-dimensional, multigroup, time-dependent, diffusion-theory model. NSA

N67-22323# Los Alamos Scientific Lab., N. Mex.
ESTIMATES OF THE POSSIBILITY OF HYDROGEN EMBRITTLEMENT OF TANTALUM IN THE FRCTF
Cornal Wohlberg 12 Aug. 1966 51 p ref
(Contract W-7405-ENG-36)
(LA-3508-MS) CFSTI: HC $3.00/MF $0.65

An evaluation was made of the possibility of destructive hydriding of Ta in the FRCTF. The assumption was made that even if the Na used in the reactor is well gettered in advance, undetermined amounts of H_2 will get into the system during installation of fuel elements and subsequent operations. The partial pressures of H_2 over Na were estimated on the basis of data from the literature. Equilibria between the H_2 in the Na and Ta were calculated. The H_2 picked up by Ta from Na cold trapped at 125°C will reach an equilibrium value of 40 ppM. Na that is not continuously cold trapped may hydride the Ta at 600°C to levels well above the known $TaH_{0.76}$ phase. The literature gives little information of use on the embrittling effect of H_2 in the range of 500–600°C. However, a level of 800–900 ppM H_2 ($TaH_{0.16}$) will embrittle Ta at room temperature. Since the amounts of possible H_2 contamination from various sources can not be estimated (H_2O, air, oils), continuous cold trapping, or another method of removal, is definitely indicated. In order to visualize the

actual amounts of H_2 that may be tolerated in the system, estimates were made of the total weights of H_2 that would need to be absorbed by the Ta for various concentrations. A conservative estimate is that 0.180 kg H_2 in the reactor may raise the H_2 content of the fuel capsules to about 1000 ppM. In all of the computations made, some rather extreme extrapolations had to be made because of lack of data, particularly on the partial pressures of H_2 over unsaturated Na solutions. These extrapolations and collateral assumptions were stressed to indicate the type of information that is needed. Author (NSA)

N67-22329# Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS Quarterly Technical Progress Report, Jul.–Sep. 1966
Sep. 1966 173 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-12175) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: stability and properties of cladding and structural alloys in a high temperature, liquid metal, fast neutron environment; boiling studies for sodium reactor safety; fast spectrum Doppler measurements; Na component development; sodium reactor experiment operation; Piqua development; reactor physics; reactor fuels and materials; high temperature reactor fuels and materials; Na chemistry; reactor safety; fission product and contamination control; characterization of Na fires and fission product release; high temperature and radiation chemistry; electronic structure of metals and alloys; and radiation damage in crystalline solids. NSA

N67-22338# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
EVALUATION OF THORIUM FUELS FOR THE HEAVY WATER ORGANIC COOLED REACTOR
M. W. Croft, L. B. Gross, F. M. Alcorn, C. A. Burkart, T. C. Engelder et al Jul. 1966 235 p refs
(Contract AT(38-1)-393)
(BAW-393-7) CFSTI: HC $3.00/MF $0.65

ThO_2 fuels are evaluated for the heavy water organic cooled reactor (HWOCR). The long-range objective of the Th fuel cycle development is the proof of performance of Th fuel elements in an HWOCR environment. The types of fuel elements studied were Th metal nested cylinders, ThO_2 clustered pins, and ThC clustered pins. The economics and fuel utilization of the three fuel element types were evaluated for use in HWOCR. Technical feasibility and development costs were considered in the selection process. A test program was planned in conjunction with the optimization studies. On the basis of the comparative evaluation it is recommended that both the oxide and the metal fuel elements be carried through several phases of irradiation testing before a final selection is made. Priority should be given to the development of the ThO_2 fuel element. Author (NSA)

N67-22339# Sandia Corp., Albuquerque, N. Mex.
PAD-ABORT THERMAL FLUX MODEL FOR LIQUID ROCKET PROPELLANTS
F. D. Kite and B. E. Bader Nov. 1966 17 p refs
(Contract AT(29-1)-789)
(SC-RR-66-577) CFSTI: HC $3.00/MF $0.65

A model of the thermal environment resulting from the on-pad abort of a liquid propellant launch vehicle is presented. Author (NSA)

N67-22389# Atomics International, Canoga Park, Calif.
PIQUA NUCLEAR POWER FACILITY REACTOR OPERATIONS ANALYSIS PROGRAM Semiannual Progress Report, Jul. 1, 1965–Jan. 13, 1966
W. S. De Bear, T. Y. Fukushima, A. I. Hansen, D. Tondi, J. D. Perret et al 25 Oct. 1966 80 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11995; SAPR-7) CFSTI: HC $3.00/MF $0.65

The reactor continued to operate during the start of the current report period with one of the two main pumps shut down to reduce flow and thereby minimize the in-vessel filter pressure drop. One pump operation continued uninterrupted until July 18, 1965, when the reactor was shutdown for modifications, maintenance, and in-vessel filter replacement. Reactor startup was initiated September 6, and after preliminary warmup and testing, power operation was initiated. On October 10, one outer ring control rod was intentionally dropped into the core to determine the effect of its insertion and withdrawal on channel coolant outlet temperature. Increasing channel coolant outlet temperature in conjunction with a superheater leak necessitated reactor shutdown October 12. During the shutdown, fuel shuffling was accomplished which increased the core loading from 67 to 70 fuel elements. The reactor was made critical on October 23, and power operation was resumed on October 24. On October 26, the position indicator coil for Control Rod No. 11 failed. Loss of the position indicator necessitated the full insertion and deenergization of this rod. Operation was then uninterrupted until November 24, when it became necessary to shut the reactor down to permit repair of tube failures in the condenser of the decay heat removal system. Reactor operation resumed after 13 hr. The reactor operated continuously throughout the month of December and into January with problems in the control rod electrical circuitry continuing. On January 13, the reactor scrammed from a spurious low degasifier level signal. The original switch failed because of excessive exposure to external heat. After corrective action had been taken by installing a new switch and after temporarily repairing control rod electrical circuitry prestartup tests were made which indicated the necessity for an extensive repair program before reactor operation. NSA

N67-22440# Kernforschungsanlage, Juelich (West Germany). Laboratorium fuer Radioaktive Festkoerper.
IMPROVING ECONOMY WITH THE USE OF STANDARDIZED, MOVABLE, IN-CELL BOXES, AND THE DECONTAMINATION OF THEIR EQUIPMENT AT THE CENTRAL DECONTAMINATION FACILITY
G. Brinkmann, W. Schenk, W. Schulz, and F. Stockschlaeder Apr. 1965 16 p ref *Its* Paper No. 38
(JUL-252-RW) CFSTI: HC $3.00/MF $0.65

When a nuclear research center has several hot laboratories, all of which use in-cell boxes, it is desirable to standardize the cells and boxes as far as possible in order to achieve maximum economy, efficiency, and convenience. The report shows the principles of planning which are laid down in connection with the construction of several plants. It enumerates the advantages and describes the conditions which must be observed during planning. The section on the decontamination facility is included as an important part of the entire box-exchange system. In addition, some of the more interesting points of equipment and techniques, especially a new manipulator exchange technique, are described. Author

N67-22467# Kernforschungsanlage, Juelich (West Germany). Laboratorium fuer Radioaktive Festkoerper.
DISASSEMBLY OF TEST IRRADIATIONS AND FUEL ELEMENTS IN SMALL CAST IRON, ALPHA–GAMMA-CELLS AND THEIR SUBSEQUENT HANDLING
P. J. Schmiddem, W. Stephan, and K. Zamja Apr. 1965 20 p refs
(JUL-253-RW) CFSTI: HC $3.00/MF $0.65

Three fairly small alpha–gamma cells, made from cast iron blocks, are being built for disassembling of test irradiations and fuel elements. Aside from disassembly equipment, the cells will enable the usual critical evaluation of the performance of the fueled

section. The cells use gas-tight stainless steel boxes with double-cover alpha–gamma locks between boxes and to the outside. Special gas-tight, extended reach manipulators of a shortened design with a shielded through-wall plug are used. These manipulators are gas-tight and do not require plastic bootings for sealing to the boxes. Some equipment (periscope, dimensional measurement, gamma-scan) is of special design in order to save space in the narrow boxes. Author

N67-22479# Atomic Energy Establishment, Winfrith (England). Reactor Development Div.
A NEW CORRELATION OF NON-UNIFORMLY HEATED ROUND TUBE BURNOUT DATA
G. J. Kirby Jul. 1966 51 p refs
(AEEW-R-500) HMSO: 7s

The new correlation fits the available data better than any previously published correlation—the root mean square deviation being 5.7% for all data at 1000 psia and the worst fit being to data at 2000 psia, where the rms. error is 6.6%. The correlation is used to investigate the effect of flux profile changes and no significant increase in burnout power is obtained by modifying the present chopped cosine distribution. Author

N67-22845*# Aerojet-General Corp., Azusa, Calif.
SNAP-8 THIRD LOOP OPTIMIZATION
E. F. Perez, F. R. Cleveland, and L. Rico 22 Apr. 1963 66 p refs
(NASA-CR-72213; TM-345-63-1-106) CFSTI: HC $3.00/MF $0.65 CSCL 18N

A summary of the investigations conducted to define optimum operating parameters for the SNAP-8 third loop is presented. Eutectic NaK and OS-124 were considered as coolant fluids for this loop. A comparison is made between the fluids on the basis of optimum equivalent weights. Also included are analyses developed for optimizing design parameters for the heat exchanger, condenser and the flat tube and fin radiator. Author

N67-22847* Aerojet-General Corp. Azusa, Calif.
INVESTIGATIONS OF THE SNAP-8 LUBE AND COOLANT LOOP
E. F. Perex and W. W. Tingle 3 Dec. 1964 65 p refs
(NASA-CR-72218; TM-340-64-1-255) CFSTI: $3.00 CSCL 18N

Additional lube and coolant loop investigations were conducted. Digital computer programs were prepared to conduct radiator design evaluations and to permit off design performance evaluations of the L/C loop. These digital computer programs were used in the evaluation of L/C operating parameters. The effect of vehicle acceleration on the L/C loop was also analyzed and the best location for the L/C expansion reservoir to accommodate the effects of the acceleration, was determined. Author

N67-22849*# Aerojet-General Corp., Azusa, Calif.
CYLINDRICAL RADIATOR ANALYSIS WITH INTERIOR INSULATED
E. F. Perez and J. Edberg 22 Apr. 1963 9 p ref
(NASA-CR-72210; TM-345-63-1-108) CFSTI: HC $3.00/MF $0.65 CSCL 18N

An investigation was made to evaluate the sizes and weights of cylindrical radiators for use in the SNAP-8 heat rejection system. The radiators were sized to provide the required heat rejection, while operating with the maximum external heat load from solar and planetary sources, using OS-124 or NaK as the cooling fluids. The interiors of the cylinders were considered to be insulated with heat radiating from the outside surface of the radiation only. The resulting optimum radiator sizes were compared to an optimum flat radiator configuration. Author

N67-22850*# Aerojet-General Corp., Azusa, Calif.
WEIGHT-AREA TRADE-OFF STUDY FOR A FLAT SNAP-8 RADIATOR
E. F. Perez and D. L. Forrest 22 Apr. 1963 10 p ref
(NASA-CR-72209; TM-345-63-1-103) CFSTI: HC $3.00/MF $0.65 CSCL 18N

An analysis was made to permit evaluation of the trade off between radiator area and weight. A method was developed to determine the optimum manner in which the radiator projected area can be reduced with a minimum increase in radiator weight. Author

N67-22853# Aerojet-General Nucleonics, San Ramon, Calif.
SEDAN–SNAP-8 DATA ANALYSIS PROGRAM
D. Yee Jan. 1966 131 p refs
(NASA-CR-72212; TM-4923-66-373) CFSTI: $3.00 CSCL 18K

SEDAN is a series of 3 IBM-7094 computer programs written to analyze steady-state data obtained from the following SNAP-8 test loops. 1) SL-1/PCS-1 Phase 1, 2) RPL-2 Stage 1, and 3) PCS-1 Phase 4. The analysis consist of statistically deriving a set of consistent state point values from the loop instrument readings and to use these values to calculate component performance parameters. Author

N67-22855*# Aerojet-General Corp., Azusa, Calif.
ACCELERATED EROSION TESTING OF CANDIDATE SNAP-8 TURBINE ROTOR AND NOZZLE MATERIALS
H. E. Bleil 5 Feb. 1964 9 p
(NASA-CR-72199; TM-390-64-4-207) CFSTI: HC $3.00/MF $0.65 CSCL 18J

Materials specimens were exposed to a wet mercury vapor erosion environment. The environment was produced in a boiling condensing, closed pumped loop. Specimens were evaluated for resistance to erosion using weight changes as the criteria. Stellite 6B, a cobalt base alloy, exhibited greater resistance to erosion in the environment than the other materials tested. Author

N67-22858*# Aerojet-General Corp., Azusa, Calif.
A STUDY OF CONDENSER INVENTORY CONTROL FOR THE SNAP-8 SYSTEM
I. P. Wishney 1 May 1964 26 p
(NASA-CR-72216; TM-340-64-1-228) CFSTI: HC $3.00/MF $0.65 CSCL 18N

The results of a study to determine the effectiveness of a mercury inventory control system to regulate condensing pressure within limits bounded by mercury pump cavitation on the low side and turbine output power requirements on the high side, are presented. The results show that the inventory control system can regulate condensing pressure within system limits although it is more effective in its ability to increase condensing pressure than to reduce it. Limitations exist involving system instability for narrow pressure regulation and the biasing effects which could result from vehicle acceleration. Author

N67-22880* Aerojet-General Nucleonics, San Ramon, Calif.
MERCURY CORROSION AND EVALUATION OF CORROSION PRODUCT SEPARATORS IN 9 Cr-1 Mo BOILING THERMAL CONVECTION LOOPS
M. F. Parkman 18 Feb. 1964 69 p refs
(NASA-CR-72200; TM-390-64-4-205) CFSTI: $3.00 CSCL 18N

Three 9Cr–1Mo boiling thermal convection loops were operated for 1000 hrs at 1075°F boiling-condensing, 1250°F superheat, and 500°F subcooled temperatures. A similar loop was operated at 700°F boiling-condensing, 800°F superheater, and 500°F subcooled temperatures. Flow rate in all cases was 7.2 lbs/hr, equivalent to 2.0 lbs/hr-in^2 of condenser surfaces. Corrosion product separators consisting of a magnet section, a columbium wool section, and an

iron wool section were included in the liquid leg of two of the 1075°F loops. Results are discussed. Corrosion products were found in the separators; the trapping mechanism appeared to be simply one of presentation of a large surface and a long residential time. No preferential trapping by either wool was noted. The mercury was subcooled to 500°F before entering the traps. More than half of the recovered corrosion products was deposited in the region ahead of the trap; some occurred after the trap, but was not recovered. Preliminary boiling stability tests were conducted in full scale glass models of the loop and in one of the 9Cr-1Mo loops. Author

N67-22866*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ESTIMATING THERMAL CONDUCTIVITY OF CERMET FUEL MATERIALS FOR NUCLEAR REACTOR APPLICATION
John V. Miller Washington, NASA, Apr. 1967 30 p refs
(NASA-TN-D-3898) CFSTI: HC$3.00/MF$0.65 CSCL 18J

Several analytical methods that can be used to predict the conductivity in a cermet fuel material system were examined, and each was found to be valid over certain ranges. Some of the work being done on cermet fuels, however, is in a region that is not specifically covered by any of the models. Because of the similarity between two of the analytical models, a method that, in essence, allows extrapolation into this undefined region is suggested. Comparison with available experimental values shows that the suggested method results in favorable predictions and could, therefore, be used to estimate the thermal conductivity of potential cermet fuel materials. Data were then generated by this method to illustrate the thermal conductivity behavior of a typical cermet fuel (tungsten–uranium dioxide) under various conditions. Author

N67-22904# Aktiebolaget Atomenergi, Stockholm (Sweden).
THE INTERACTION BETWEEN CONTROL RODS AS ESTIMATED BY SECOND-ORDER ONE-GROUP PERTURBATION THEORY
Rolf Persson Oct. 1966 44 p refs
(AE-250) CFSTI: HC$3.00/MF$0.65

The interaction effect between control rods is an important problem for the reactivity control of a reactor. The approach of second-order one-group perturbation theory is shown to be attractive due to its simplicity. Formulas are derived for the fully inserted control rods in a bare reactor. For a single rod a correction b is introduced, which with good approximation is proportional to the strength of the absorber. For two or more rods an interaction function $g(r_{ij})$, which is assumed to depend only on the distance r_{ij} between the rods. The theoretical expressions are correlated with the results of several experiments in RO, ZEBRA and the Agesta reactor, as well as with more sophisticated calculations. The approximate formulas are found to give quite good agreement with exact values, but in the case of about 8 or more rods higher-order effects are likely to be important. Author (ESRO)

N67-22907 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE NEUTRON DIFFUSION PARAMETERS OF EPOXY RESIN [PARAMETRY DYFUZYJNE ZYWICY EPOKSYDOWEJ]
A. Graffstein, T. Rzeszot, and E. Warda Jun. 1966 10 p refs
(INR-731/IXA/R) CFSTI: HC$3.00/MF$0.65

The thermal neutron diffusion parameters of epoxy resin have been measured using pulsed neutron method. As a pulsed neutron source, the fast chopper operating at the horizontal channel of the EWA reactor has been used. The measurements have been performed in the buckling range of 0.068 to 0.868 cm^{-2}. Author

N67-22912 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SOME COEXTRUSION EXPERIMENTS OF ALUMINUM CLADDED CERMETALLIC CORE RODS [NIEKTORE BADANIYA NAD WSPOLBIEZNYM PRETOW ALUMINIOWYCH Z RDZENIEM CERMETALICZNYM]
W. Rutkowski, W. Szteke, and M. Wieczorkowski Jun. 1966 21 p refs
(INR-728/XIV/R) CFSTI: HC$3.00/MF$0.65

In the experimental series concerning EK 10 fuel element, some preliminary work was done on coextrusion of metallic tubes with metallic and ceramic powder cores. Aluminum was used as cladding material and Al, Mg, Cu and Al_2O_3 powders and their mixtures were used as core material. Some interesting conclusion reported in the paper could be drawn from the experiment results. Author

N67-22921# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
THE BR2 TESTING REACTOR AND ITS CONNECTED LABORATORIES Annual Progress Report, 1965
Brussels, EURATOM, Nov. 1966 39 p
(Contract EURATOM-006-60-5 BRAB)
(EUR-3138.e) CFSTI: HC$3.00/MF$0.65

The BR2 testing reactor operated for 190 days without any noteworthy incident. The reactor core was enlarged in order to obtain more irradiation channels. The maximum thermal neutron flux was raised to 10^{15} n/cm^2sec, the rated reactor power being 57 MW. Some 150 devices were irradiated during the year so that 35–40 channels were continuously occupied in the reactor, mainly for the member states of the European Community, but also for UKAEA and other foreign countries. Reference is made to many irradiation devices developed and fabricated by GEX. The MFBS Loop was put into operation and the first irradiation of a sodium-cooled Pu-fuel pin was carried out for the Rapsodie project. The dismantling cell was occupied full-time. The medium-activity hot laboratories were prepared for operation. Author

N67-22922# Kernforschungsanlage, Juelich (West Germany).
THERMIONIC [THERMIONIK]
D. Wickmann Aug. 1963 23 p refs In GERMAN
(JUL-BIBL-1) CFSTI: HC$3.00/MF$0.65

A bibliography is presented of works on the use of thermionic cells in reactors. The listing includes titles on high temperature fuel elements, particularly on cladding and canning. The list was compiled from articles published in eight pertinent periodicals since January 1963. Transl. by K.W.

N67-22924 Compagnie d' Ingenieurs et Techniciens d' Etudes, Paris (France).
THEORETICAL AND EXPERIMENTAL STUDIES OF A NEW PRESTRESS PROCEEDING [ETUDE THEORIQUE ET EXPERIMENTALE D'UN NOUVEAU PROCEDE DE PRECONTRAINTE]
Brussels, EURATOM, 1966 62 p In FRENCH
(Contract EURATOM-045-65-3 TEGF)
(EUR-3264.f) CFSTI: HC$3.00

A global prestressing process for application to nuclear reactor caissons is described. Satisfactory model test results are reported. Studies undertaken for the utilization of this process are cited for application to an INCA-type reactor. A general method of calculating the strength of materials is worked out by the theory of plates and shells. The principle is outlined for calculating the internal stresses and strains by using a two-dimensional method of thermoelasticity. Transl. by R.Ll.

N67-22928# Kernforschungsanlage, Juelich (West Germany). Institut Fuer Reaktorentwicklung.
ENERGY TRANSFER USING THE MOSEL REACTOR [ENERGIEUEBERTRAGUNG BEIM MOSEL-REAKTOR]

H. Heinrichs Nov. 1966 43 p In GERMAN
(JUL-422-RG) CFSTI: HC$3.00/MF$0.65

Cooling systems for a Molten-Salt Reactor (MSRE) are thermodynamically evaluated. For cooling a reactor with an output of 2500 MW_{th}, a normal tube heat exchanger was considered for salt, lead, and sodium coolants, and a direct-contact heat exchanger was considered for lead, both systems to be applied internally and externally. The direct-contact heat exchanger was found to be best suited for studies of existing problems. Calculations were performed for a stream generator integrated with single heat exchangers for additional energy transfer in order to estimate the absolute and relative characteristic quantities attainable. Results indicate that the size of a steam generator is governed by the water-steam characteristics rather than by the heating medium. Transl. by K.W.

N67-22930# European Atomic Energy Community, Ispra (Italy).
COSTANZA—CYLINDRICAL. A CYLINDRICAL ONE DIMENSIONAL DYNAMICS CODE FOR LIQUID-COOLED MULTI-CHANNEL NUCLEAR REACTORS
A. Agazzi, G. Forti, and E. Vincenti Brussels, EURATOM, Nov. 1966 67 p refs
(EUR-3171.e) CFSTI: HC$3.00/MF$0.65

The Fortran 2 version 3 Code Costanza Cylindrical is a two-group reactor dynamics code in one spatial dimension (radial). Up to 10 different composition zones and 10 cooling channels are allowed. Each channel consists of a fuel zone, gap, cladding, and coolant. The thermal resistance of gap and the heat transfer coefficient at every axial level are variable functions of thermodynamic parameters. Inlet coolant temperatures and velocities may be given in input for each channel as tabulated functions of time as well as axial power distribution as function of space. Up to 10 delayed neutron groups are considered. Control rods are simulated as diluted thermal poison in each zone which may be varied in time independently according to any given law. In the initiation of each problem, criticality may be searched for by varying poison insertion in any wanted zone. Feedback reactivities in each zone are considered for both fuel and coolant average temperatures by linear coefficients for p and $\Sigma_{a\,th}$. A free test routine may be used to insert new specifications when any wanted conditions are reached during transients. Author

N67-22960# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
USE OF CADMIUM IN SOLUTION IN THE EL4 REACTOR MODERATOR-IRREVERSIBLE FIXING OF CADMIUM ON THE METALLIC SURFACES [UTILISATION DU CADMIUM EN SOLUTION DANS LE MODERATEUR DU REACTEUR EL4 FIXATION IRREVERSIBLE DU CADMIUM SUR LES SURFACES METALLIQUES]
O. Croix, O. Paoli, J. Lecomte, L. Dolle, and V. Legallic Aug. 1966 28 p refs Transl. into ENGLISH from the French Rept. CEA-R-2504, Aug. 1964
(AECL-2490; CEA-R-2504) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

During studies on the poisoning of the EL4 reactor by cadmium sulphate, measurements were made by two different methods of the residual amounts of cadmium liable to be fixed irreversibly on the surfaces in contact with the heavy water. A marked influence of the pH was noticed. The mechanism of the irreversible fixing is compatible with the hypothesis of an ion-exchange in the surface oxide layer. In a sufficiently wide range of pH the cadmium thus fixed causes very little residual poisoning. The stability of the cadmium sulphate solutions is however rather low in the conditions of poisoning. Author

N67-22977# Oesterreichsiche Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
RESEARCH PROGRAM FOR HYDRO- AND THERMODYNAMIC INVESTIGATIONS IN SINGLE- AND TWO-PHASE FLOW
H. Schmidt [1966] 44 p refs Presented at the Comm. Meeting on Reactor Safety Technol., Paris, 2–4 Nov. 1966
(SGAE-RE-7/1966) CFSTI: HC$3.00/MF$0.65

A research program is described in which hydrodynamic and thermodynamic investigations of single- and two-phase flows will be carried out to gain further information on the operating behavior of boiling water reactors. The program centers around three main topics: reactor safety, dynamics of the elements of a reactor plant, and basic investigations into the dynamics of heat transfer and turbulence. The studies of reactor safety will emphasize stability, burnout, and critical flow. A description is given of the testing facility, and details are given on the following topics: instrumentation, data handling system, electrically heated test length, heat exchanger, and axial heat exchange. L.E.W.

N67-22979# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Reaktorentwicklung.
PROBLEMS OF A SODIUM-LOOP DESIGNED TO OPERATE AT TEMPERATURES UP TO 800°C
E. Matyas, G. Rajakovics, and N. Schwarz [1966] 17 p Presented at the Symp. on Alkali-Metal Coolants Corrosion Studies and Systems Operating Experience, Vienna, 28 Nov. 1966 Prepared in cooperation with Gebrueder Boehler and Co.
(SGAE-RE-61966) CFSTI: HC$3.00/MF$0.65

The problem of corrosion resistance in a sodium loop designed to operate at 800°C is discussed. The possibility of developing new steels and alloys with better resistance is mentioned, and heat transfer studies are suggested to support component development with the aim of increasing economy. For this purpose very small sensing devices will have to be developed for operation at elevated temperatures. Details are given on the components and layout of the sodium rig, mixing chambers with bypass flow scheme, heat exchanger, corrosion test section, and auxiliary oil system. L.E.W.

N67-22985# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE EFFECT OF FAST NEUTRON IRRADIATION ON THE TENSILE PROPERTIES OF SPECIMENS FROM COLD-WORKED ZIRCONIUM-2.5 WT% NIOBIUM PRESSURE TUBES
G. W. Parry Nov. 1966 19 p refs
(AECL-2625) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Transverse and longitudinal tensile specimens from two cold-worked zirconium-2.5wt% niobium pressure tubes were irradiated in a fast neutron rod at 300°C. As usual, irradiation increased the yield and ultimate tensile strengths and decreased the ductilities to about 50% of the unirradiated values. A greater % increase in yield strength is observed in longitudinal specimens than in transverse specimens and this is discussed in terms of the effect of irradiation on slip and twinning deformation systems. The effect of hydrogen concentrations up to 200 ppm in unirradiated and irradiated specimens is small. Author

N67-22987# Atomic Energy Establishment, Winfrith (England). Fast Reactor Physics Div.
THE F.D. 2 GROUP AVERAGED CROSS SECTION SET FOR FAST REACTOR CALCULATIONS
R. W. Smith, J. L. Rowlands, and D. Wardleworth Aug. 1966 70 p refs
(AEEW-R-491) HMSO: 9s

The F.D. 2 set is a thirty-three group cross section library produced for sodium cooled fast reactor calculations. The data

was derived mainly from the UKAEA Nuclear Data Library using the Galaxy program and a smooth weighting spectrum which approximates that of a large sodium cooled fast reactor. With the exception of the highest energy group, the group boundaries are at half lethargy intervals based on an origin at 10 MeV. The top group covers energies above 3.68 MeV and has a U-235 fission spectrum weighting. The remaining 32 half lethargy groups cover the energy range down to 0.414 eV. The scatter matrix was limited to ten down-scatter groups with scattering to lower energies included in the scattering to the tenth down-scatter group. C.T.C.

N67-23008 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

DETERMINATION OF Δ^{28} PARAMETER IN "ANNA" REACTOR LATTICES [WYZNACZANIE PARAMETRU Δ^{28} W SIATKACH REAKTORA ANNA]

E. T. Josefowicz Aug. 1966 25 p refs
(INR-748/IXA/PR) CFSTI: $3.00

δ^{28} parameter measurements were performed in four zero power reactor lattices: water–graphite moderated with 14.0 and 19.8 cm pitches and only graphite moderated with 14.0 and 19.8 cm pitches. The method involves the irradiations of pellets of fuel material/enriched UO_2+Al/ together with dysprosium foils in a hole drilled in the multitube fuel element and the irradiation of the same detectors in the thermal spectrum. Neptunium is separated from the irradiated pellets by reversed phase partition chromatography using TTA as complexing and extracting agent and Np^{239} gamma activity is determined as the measure of absorption rate in U^{239}. The results for δ^{28} are given separately for each fuel tube; they change from about 1.3 to 5.8 (the latter for highly undermoderated lattice 14.0 cm pitch without water). Author

N67-23028# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperiments.

PULSED REACTOR-REFERENCES [GEPULSTE REAKTOREN-LITERATURHINWEISE]

F. Krueger Jul. 1964 18 p refs In GERMAN
(JUL-BIBL-9) CFSTI: HC $3.00/MF $0.65

This literature review lists publications on pulsed nuclear reactors. Development programs, expected output, neutron dosimetry and safety hazards, etc. are considered. Transl. by G.G.

N67-23030# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorentwicklung.

PHYSICAL PROPERTIES OF FLUORIDE MOLTEN SALTS, WITH SPECIAL APPLICATION TO THE MOSEL REACTOR CONCEPT [PHYSIKALISCHE STOFFWERTE VON FLUORIDSALZ-SCHMELZEN, SPEZIELLE ANWENDUNG AUF DAS MOSEL-REAKTORKONZEPT]

H. W. Vornhusen May 1965 37 p refs In GERMAN
(JUL-268-RG) CFSTI: HC $3.00/MF $0.65

Considered were the various physical properties of fluoride molten salt combinations that find application in fuel element salts or blanket-cooling systems for nuclear reactors. Evaluated were densities of their solid and molten state, specific heat, viscosity, heat conductivity, melting point, and boiling point. Emphasis was placed on the molten salt epithermal reactor and its cooling system. Transl. by G.G.

N67-23032# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorentwicklung.

AN EVALUATION OF THORIUM FUEL CIRCULATION [EINE BEWERTUNG VON THORIUM-BRENNSTOFFKREIS-LAEUFEN]

Paul R. Kasten Jun. 1965 169 p refs In GERMAN
(JUL-276-RG) CFSTI: HC $3.00/MF $0.65

Evaluation of thorium fuel cycles for breeder reactors seems to be most promising for a spectral-shift reactor system at a conversion rate of 0.8 under recycling conditions. This cycling system can be adapted for a graphite moderated molten salt reactor, for a gas-cooled reactor, and for a reactor using a homogenous water-sludge-mash mixture for cooling. Fast thorium reactors with solid fuel elements produce lower breeding rates than comparable plutonium systems, but possess a higher security factor. Transl. by G.G.

N67-23033# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Medizin.

EQUIPMENT FOR LOCAL IRRADIATION OF TRANSPLANTED MOUSE TUMORS WITH THERMAL NEUTRONS IN REACTOR FRJ-1 [EIN EINRICHTUNG ZUR OERTLICHEN BESTRAHLUNG VON TRANSPLANTIERTEN MAEUSETUMOREN MIT THERMISCHEN NEUTRONEN AM REAKTOR FRJ-1]

W. Porschen Feb. 1966 38 p refs In GERMAN
(JUL-358-ME) CFSTI: HC $3.00/MF $0.65

The described irradiation facility serves the therapeutic tumor treatment of very small animals and possesses a thermal neutron flux strength of about $2.2 \times 10^9 n/cm^2 sec$. and a gamma dosage ability of 400 r/h. Its characteristics are a CO_2 tank, an antimony shield of 10 cm thickness, and an isolated plexiglass neutron collector. Irradiated animals are enclosed in a lithium-paraffin shield to eliminate overall body irradiation and direct the radiation source to the proper location. Transl. by G.G.

N67-23062# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.

HEAT TRANSFER, IMPURITIES AND FOULING IN ORGANIC COOLANTS (A SUMMARY OF CANADIAN EXPERIENCE)

S. R. Hatcher, B. A. Finlay, and J. L. Smee May 1966 35 p refs Presented to the Intern. Atomic Energy Agency Panel on the Use of Organic Liquids as Reactor Coolants and Moderators, Vienna, 9–13 May 1966
(AECL-2642) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

The results of the Canadian work on forced convection heat transfer can be expressed by a modified Dittus Boelter correlation, and have been confirmed by reactor fuel irradiations. The WR-1 reactor fuel design, based on a burnout safety factor of two using data from the Core and Sato correlation, was adequate, but an improved criterion of safety is presented. The impurities found in organic coolants are discussed with particular emphasis on fouling and the hydriding of zirconium alloys. Chlorine and oxygen should be avoided in the coolant, but the presence of about 100 ppm water reduces both fouling and hydriding rates. Results from the X-7 in-reactor loop demonstrated that fuel can be irradiated to high burnup with negligible fouling. However the fouling in the larger U-3 loop is somewhat higher, probably due to the higher radiolytic damage rate in the coolant. Radiation, the presence of oxygen, and absence of water increased the fouling potential in the U-3 loop. Coolant temperature and rate of purification by clay adsorption had little effect. Methods for control of impurity levels are discussed. Further development is required to assess the relative merits of coolant processing methods necessary to achieve minimum fouling of the fuel. Author

N67-23065# Kernforschungsanlage, Juelich (West Germany). Laboratorium fuer Radioaktive Festkoerper.

DISASSEMBLY AND SAMPLING OF GRAPHITE BALL FUEL ELEMENTS

H. Erfurth, F. Stockschlaeder, and M. Ulrich Apr. 1965 17 p /ts Paper No. 53
(Jul-250-RW) CFSTI: HC $3.00/MF $0.65

As part of postirradiation examination program, in which irradiated graphite ball fuel elements must be examined and

prepared for advanced experiments, two special pieces of equipment were developed for breaking open the graphite shell and sampling the fuel element. The first item is a lathe machining device which serves to cut a circumferential "V" groove in the ball to assist in splitting and to core-drill samples from the outer graphite shell. The second item is the graphite ball splitter which cuts the ball into roughly equal pieces along the "V" groove with a motor drive blade. Schematic drawings, photographs, and descriptions of each piece of equipment are included. Contamination from dust generated in the process is avoided by the use of a vacuum cleaner. R.N.A.

N67-23066# Kernforschungsanlage, Juelich (West Germany). Laboratorium fuer Radioaktive Festkoerper.

PACKAGING DISASSEMBLED FUEL ELEMENTS AND RADIOACTIVE WASTE IN THE HOT CELLS AT THE KERNFORSCHUNGSANLAGE JUELICH

A. Retz, P.-J. Schmiddem, W. Stephen, and J. Rau Apr. 1965 24 p refs

(Jul-249-RW) CFSTI: HC$3.00/MF$0.65

Depending on type of material, activity level, and fire and health hazard, several methods of waste and fuel packaging are used in hot cells. Low level wastes such as plastics, rags, and small tools are remotely welded into plastic bags of 0.2–0.4 mm thickness. Wastes of higher activity level are packed into disposable cans. Tests of the tightness of the containers are described. For highly-active fuel wastes which must be most securely packaged and stored, three methods have been tested: 1) remote argon-arc welding of stainless-steel and aluminum cans, 2) electromagnetic closing of aluminum cans, and 3) cold-pressure welding of aluminum cans. By comparison of leak-tightness, resistance to mechanical damage, and costs, the method of cold-pressure welding has been chosen. Author

N67-23093# European Atomic Energy Community, Brussels (Belgium).

THERMOCOUPLE COMPOSITION CHANGES DUE TO NEUTRON IRRADIATION

H. Ehringer, C. Mongini-Tamagnini, and C. Ponti Oct. 1966 43 p refs

(EUR-3156.e) CFSTI: HC$3.00/MF$0.65

The methods employed to calculate thermocouple composition changes in thermal reactors are described. For each of the considered elements (Pt, Rh, Mo, Fe, Ru, Pd, Ni) a reaction chain has been constructed, and the corresponding set of differential equations has been solved by means of a Fortran program on an IBM 7090 computer. Some interesting results concerning the reliability of the considered thermocouples are discussed. Author

N67-23097# Kernforschungsanlage, Juelich (West Germany). Projektabteilung.

REACTOR PRESSURE VESSELS MADE OUT OF PRESTRESSED CONCRETE—SHORT OUTLINE OF DEVELOPMENT TO DATE [REAKTORDRUCKGEFAESSE AUS SPANNBETONKURZER ABRISS DES HEUTIGEN ENTWICKLUNGSSTANDES]

Harald Luks Jul. 1966 41 p refs In GERMAN

(JUL-350-VW) CFSTI: HC$3.00/MF$0.65

Considered is the use of prestressed concrete pressure vessels in power reactors. The requirements for pressure vessels in power reactors are defined, and the use of steel and concrete are compared. Evaluated are also construction characteristics, geometry, concrete technology, heat insulation, cooling, and lining. Model tests are discussed, and several examples of prestressed concrete pressure vessels now used in reactor operations are given. Transl. by K.W.

N67-23198# Argonne National Lab., Ill.

FAST REACTOR TEST FACILITY (FARET). VOLUME II: SUMMARY OF PRELIMINARY SAFETY ANALYSIS

J. D. Geier, Ed. Apr. 1966 179 p refs

(Contract W-31-109-ENG-38)

(ANL-7168, Vol. 2) CFSTI: HC$3.00/MF$0.65

This volume covers the safety analysis and related work which took place during AEC considerations of the FARET preliminary safety analysis. The possible circumstances leading to the maximum credible accident and its subsequent effects are described and evaluated. Results are given of other analyses which were performed on less serious accidents. A summary of Volume I (facility description) is given in the appendices. NSA

N67-23229# Bettis Atomic Power Lab., Pittsburgh, Pa.

BEHAVIOR OF GASEOUS FISSION PRODUCTS IN OXIDE FUEL ELEMENTS

F. A. Nichols Oct. 1966 39 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-570) CFSTI: HC$3.00/MF$0.65

Theories of the mechanics of gas release from oxide fuels during fission, and the effect on fuel elements are discussed. Equations are developed to explain migration of fission-gas bubbles to the fuel center line, and to grain boundaries. Concepts are amplified to account for migration of pores by surface diffusion, and by vapor transport, under driving forces of thermal gradients, strain energy gradients, stressed locations, and moving grain boundaries. Diagrams are presented to indicate expected extent of columnar grain growth for UO_2, ThO_2, and ZrO_2, as a function of center line temperature in a cylindrical fuel element. NSA

N67-23235# TRW Systems, Redondo Beach, Calif. Physical Electronics Dept.

KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS Quarterly Progress Report for Period Ending 31 Mar. 1966

A. Firstenberg and L. G. Neal 15 Apr. 1966 49 p refs

(Contract AT(04-3)-372)

(STL-372-38) CFSTI: HC$3.00/MF$0.65

An experiment was performed for simultaneously measuring the power, inlet flow rate, inlet subcooling, exit void fraction, and exit momentum flux in the geometry of a simulated SPERT 1A moderator–coolant channel at atmospheric pressure. The measurement of both mass flux and momentum flux allows one to define and evaluate a single parameter chosen to characterize the distributional effects. In addition to the steady state measurements, the response of the momentum flux to power modulation was measured in the form of power-momentum transfer functions. NSA

N67-23377# Naval Radiological Defense Lab., San Francisco, Calif.

HEAT TRANSFER FROM RADIOISOTOPIC HEAT SOURCES BURIED IN THE OCEAN FLOOR

V. E. Schrock and K. Kesavan 20 Jan. 1967 55 p

(Contract AT(49-5)-2084)

(USNRDL-TRC-86; AD-645558) CFSTI: HC$3.00/MF$0.65

Data were obtained that show clearly that the modes of heat transfer of interest in a porous bottom material will be convection and nucleate boiling. In the natural convection regime, the temperature of the capsule surface above ambient is substantially lower than it would be if heat were transferred by conduction only. For the conditions of the present tests the threshhold of convection appears to be at a heat flux of 100 to 200 Btu/hr sq ft. The existence of nucleate boiling in the porous material provides very much more effective heat transfer than predicted by conduction models. Thus the capsule life should be greater. This does, however, make it essential to determine the burnout limits on the nucleate

boiling regime. Apparatus was developed and used to obtain the thermal conductivity, permeability, and porosity of Monterey sand (12 mesh) and Ottawa sand (90 mesh). It appears that at least 12 thermocouples will be necessary to adequately describe the temperature of the capsule surface. Author (TAB)

N67-23380# Naval Radiological Defense Lab., San Francisco, Calif.
MEASUREMENT OF SEAWATER CORROSION OF SNAP CONTAINER ALLOYS USING RADIOACTIVE TRACER TECHNIQUES
Don A. Kubose, Ming G. Lai, Harry A. Goya, and Herman I. Cordova 3 Jan. 1967 45 p refs
(Contract AT(49-5)-2084)
(USNRDL-TR-1092; AD-645553) CFSTI: HC $3.00/MF $0.65

Corrosion rates of Haynes 25, Hastelloy C and Hastelloy N in seawater were measured using two radioactive tracer techniques. These techniques involved (1) measurement of the radioactivity leached into seawater from radioactive alloy specimens and (2) performing neutron activation analysis of corrosion products in seawater in which inactive alloy specimens had been placed. The second technique was used to determine whether the gamma recoil from the thermal neutron activation of the alloys in the first technique had affected their corrosion properties. It was found that the gamma recoil from neutron activation had only a small effect on the corrosion rate of the alloys. The average corrosion rates obtained for Hastelloy C and Hastelloy N were 0.00005 mil per year and 0.0001 mil per year, respectively. No appreciable differential leaching of the cobalt, nickel and chromium components of these alloys was observed. The results obtained for Haynes 25 indicated differential leaching had occurred. The corrosion rate calculated from the amount of cobalt released was 0.000001 mil per year while that calculated from the amount of chromium released was 0.00001 mil per year. Author (TAB)

N67-23448 Atomics International, Canoga Park, Calif.
MERCURY RANKINE PROGRAM INTEGRATED SYSTEM TEST (PSM-3). VOLUME II: DATA CORRELATION
V. Heiskala 25 Oct. 1966 172 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11945, Vol. II) CFSTI: HC $3.00/MF $0.65

Three Prototype System Mockups have been fabricated and operated at Atomics International. They were initially operated as part of the SNAP-2 program which was recently redirected as the Mercury Rankine Power Conversion Technology program. The third system, PSM-3, which was instituted to study the startup and operation of the SNAP-2 system in a simulated zero-gravity environment, successfully operated for 706 hours and 108 start-ups. Volume I describes fabrication and operation of the PSM-3 system. Volume II presents the analysis and correlation of the test data. Author (NSA)

N67-23465*# Cincinnati Univ., Ohio.
TRANSIENT RADIATION EFFECTS ON THERMOCOUPLES
J. H. Leonard and J. S. Crutchfield [1966] 18 p refs Presented at Winter Meeting, Am. Nucl. Soc., Pittsburgh, 30 Oct.–3 Nov., 1966
(Grant NGR-36-004-014)
(NASA-CR-83079) CFSTI: HC $3.00/MF $0.65 CSCL 18D

Thermocouples of the type used in many power reactors were exposed to various levels of nuclear radiation in the AF–NETR reactor while immersed in a constant temperature medium. Measurements of voltage output obtained under these conditions indicate the existence of pronounced and reproducible transient changes in calibration of 15°F or more. The effects appear dependent on the level and possibly the rate of change of level of incident radiation. This magnitude of calibration change may be large enough to be of considerable significance in interpretation of in-pile thermocouple data. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-21981*# North American Aviation, Inc., Downey, Calif.
INVESTIGATION TO DEFINE THE PROPAGATION CHARACTERISTICS OF A FINITE AMPLITUDE ACOUSTIC PRESSURE WAVE
A. C. Peter and J. W. Cottrell Washington, NASA, Apr. 1967 98 p refs supersedes SID-65-933; See N65-34949
(Contract NAS8-11441)
(NASA-CR-736) CFSTI: HC $3.00/MF $0.65 CSCL 20A

Propagation characteristics of a finite amplitude pressure wave are analyzed to study the contribution of entropy-producing regions to the mechanism of aerodynamic noise generation. A non-linear convective wave equation in terms of entropy and a theromdynamic *J* function results. A direct analogy between the derived governing equation and those used in classical literature is obtained. An idealization of the processes considered permits the uncoupling of the equations of motion with a consequent construction of an acoustic analogy treating shock wave omission of finite amplitude acoustic waves. An engineering approach of this analogy is reflected in the concept of an extended plug nozzle, which facilitates aerodynamic noise attenuation by modifying the entropy-producing regions. Author

N67-22335# California Univ., Livermore. Lawrence Radiation Lab. Mechanical Engineering Dept.
FORCE: A COMPUTER PROGRAM FOR CALCULATING MAGNETIC FORCES DEVELOPED IN ELECTROMAGNETS
Carl D. Henning 24 May 1966 39 p refs
(Contract W-7405-ENG-48)
(UCRL-14917) CFSTI: HC $3.00/MF $0.65

The windings of an electromagnetic experience mutually induced forces according to the Laws of Ampere and Faraday. Often, as in the case of large superconducting magnets, extreme forces are produced that require the design of massive structural reinforcement. This design in turn requires detailed knowledge of the force distribution. For a simple geometry such as an infinite solenoid, hand calculations can be made without much difficulty. However, when complex magnet configurations are employed, another method of magnetic force evaluation must be sought. A general computer program, FORCE, that uses the FORTRAN II Language for digital computers, was developed. Author (NSA)

N67-22385# Los Alamos Scientific Lab., N. Mex.
COMPUTATION OF CHARGE DISTRIBUTION ON OR NEAR EQUIPOTENTIAL SURFACES
K. R. Crandall 1 Dec. 1966 48 p refs
(Contract W-7405-ENG-36)
(LA-3512) CFSTI: HC $3.00/MF $0.65

An interesting, and often practical, way of calculating the electrostatic potential and the electric field intensity in the neighborhood of a set of equipotential surfaces is to first find the charge density on each surface. Once the charge distribution is known, the problem of calculating the potential or field intensity at any point in the region is simply one of numerical integration. A straightforward method for computing the charge density is presented, employing three of the most useful tools of numerical analysis: the method of least squares, spline function approximations,

and numerical integration using Gauss quadrature. The only restriction placed on the equipotential surfaces is that they be representable by a curve in a plane, such as a surface of revolution. Author (NSA)

N67-22540# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
ACOUSTIC REVERBERATION AT THE SEA SURFACE: SURFACE AND SUBLAYER SPECTRA VIS-A-VIS SCATTERING AND REFLECTION
John J. Martin Dec. 1966 98 p refs
(Contract DA-HC-67-C-0011)
(P-284; IDA/HQ-66-5291; AD-645541) CFSTI: HC $3.00/MF $0.65

On the basis of theoretical estimates of acoustic scattering and reflection strengths of rough surfaces and turbulent volumes, acoustic and optical data are interpreted so as to develop, on the one hand, spectra of sea surface roughness and of the turbulent sea subsurface layer and, on the other, an acoustic reverberation strength correlation formula. The range of application of both of these is for wind speeds up to about 20 knots (about 10 m/sec); the spectra range between 0.05 and 5 radians/cm, and the acoustic reverberation strength correlation formula applies between acoustic frequencies of 0.6 kcps and 60 kcps. Author (TAB)

N67-22563# Marine Engineering Lab., Annapolis, Md.
EFFECTIVENESS OF ELASTIC-WALLED CONCENTRIC TUBES IN ATTENUATING FLUIDBORNE NOISE IN AN EXPANSION CHAMBER ACOUSTIC FILTER
E. Kakaley Dec. 1966 130 p refs
(MEL-448/66; AD-645111) CFSTI: HC $3.00/MF $0.65

The report describes an experimental evaluation of several internal design modifications intended to improve the fluidborne noise reduction provided by an expansion-chamber type acoustic filter over the frequency range of 40 to 1000 Hertz (Hz) modifications included: The installation of a number of combinations of elastic-walled tubes concentrically positioned in the expansion chamber. A set of many small diameter orifices drilled in two of the concentrically positioned tubes. A baffle installed at the inlet end of the expansion chamber between a single concentric tube and the expansion chamber wall. Results indicate no consistent trends or order relating attenuation and the number of concentric elastic-walled tubes in the expansion chamber, over the frequency range of interest. A significant improvement in attenuation over that obtained by the expansion chamber alone was noted, however, when the smaller of the two tubes having drilled orifices was installed. Installation of a baffle brought further improvement in attenuation. Author (TAB)

N67-22567# Harry Diamond Labs., Washington, D. C.
A GUIDE FOR TURBULENT ATMOSPHERE PROPAGATION EXPERIMENTS
Walter J. Brinks Oct. 1966 19 p refs
(HDL-TM-66-16; AD-645734) CFSTI: HC $3.00/MF $0.65

The theoretical work of major impact in the field of electromagnetic propagation through a turbulent medium has been done by V. I. Tatarski and his followers. Experimental research is needed to clarify the role of some of the quantities and concepts contained therein. This report gives the criteria required of experimental work in order that it be relevant to the theory of Tatarski, and that the experiments both complement the theory and find a logical basis in it. Author (TAB)

N67-22588# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET HOLOGRAPHY: A STATUS REPORT. I
Yuri Keander *In its* Foreign Sci. Bull., Vol. 2, No. 12 Dec. 1966 p 1–15 refs (See N67-22587 11-34) CFSTI: HC $3.00/MF $0.65

Based on a review of Soviet articles on holography, it is reported that their scientific value is questionable. The Soviet effort is considered to be a repetition of Western experiments and limited to review articles based mainly on non-Soviet sources. One exception is noted—a laser-less wave photography method, in which the generated pattern of standing waves represents an optical equivalent of the object itself. Summary data are presented on the technique. In this research, holography is defined as a special case of wave photography where the photoemulsion records a planar cross section of a standing wave in a region behind the object. In addition to the phase and amplitude of reflected light which holograms record, wave photographs reproduce the phase and spectral composition of the radiation. Experiments conducted with several different objects are assessed. M.G.J.

N67-22652*# Massachusetts Inst. of Tech., Cambridge.
ELECTRODYNAMICS OF MEDIA
L. J. Chu, W. A. Haus, G. C. Shu, J. Glaser, T. K. Gustafson et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 113–120 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

The formulation of the fundamental equations of electro-dynamics is discussed, with emphasis on obtaining correct expressions for the macroscopic force density distributions for various media. An investigation of the possibility of obtaining and amplifying laser pulses of duration shorter than the inverse bandwidth of the active medium is reported. The CO_2 transition at 10.6μ was of particular interest. For a linear bandwidth of 50 MHz, and gains and saturation levels typical of a CO_2 system, results indicated that a peak power intensity ≈1.5 kW for a Gaussian pulse of 20 nsec in width should be sufficient to show some sharpening in 6 m. These power densities are obtainable with a Q-switched pulse. Even though the model of a homogeneously broadened two-level system is an oversimplification of CO_2 laser operation, it was felt that guidelines for future study can be gleaned from these results. L.E.W.

N67-22653*# Massachusetts Inst. of Tech., Cambridge.
PHYSICAL OPTICS OF INVERTEBRATE EYES
G. D. Bernard, J. L. Allen and F. Beltran *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 121 (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Research objectives in the study of physical optics of invertebrate eyes are briefly outlined. Emphasis will be placed on understanding the effect of such structures on light scattered from and transmitted through the eye, and in understanding what they are doing for the animal. The work will involve determination of the geometry and electrical properties, measurements of optical scattering and transmission properties using actual eyes, microwave measurements of scaled models, and theoretical models. L.E.W.

N67-22667# California Univ., Riverside.
THE ELECTRICAL PROPERTIES OF SEMIPERMEABLE MEMBRANES Annual Summary Report, Jan. 1–Dec. 31, 1966
L. J. Bruner 31 Dec. 1966 48 p refs
(Contract Nonr-4443(00))
(AD-645161) CFSTI: HC $3.00/MF $0.65

The first paper of this series presented a general formulation of the problem of stationary ion flow through membranes. The second treated in detail the special case of unipolar flow across membranes separating symmetric electrolytes. This, the third paper of the series, deals with another special case, that of bipolar flow between symmetric electrolytes. It is assumed that the total current is carried by both positive and negative permeant ions. The restriction to symmetric electrolytes implies that all ions present in the membrane and surrounding solutions have valences of identical absolute magnitude. The author begins by extracting from

the general development of his first paper a set of equations appropriate to the special case being considered. A procedure for the numerical solution of the conductance problem for this case is then outlined. Numerical results are, however, presented as part of a discussion of approximate analytic methods of solution. The utility of these methods is thereby established. Author (TAB)

N67-22669# ARO, Inc., Arnold Air Force Station, Tenn.
HELIUM PUMPING BY 4.2°K CRYODEPOSITS Technical Report, Feb.–Jul. 1966
J. D. Haygood and R. Dawbarn Jan. 1967 37 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-204; AD-645511) CFSTI: HC $3.00/MF $0.65

Studies of the trapping of helium by condensing argon on a 4.2K surface indicated that this is an effective method of removing helium from vacuum systems. Pumping speeds as high as 18.3 liters/sec-sq. cm. for 77K helium (converted to 300K helium) were obtained. Exploratory tests of nitrogen and oxygen as substrate gases for helium sorption were also carried out. During these tests the capture coefficients of argon, nitrogen, and oxygen were measured and found to be near one. Author (TAB)

N67-22726# ARO, Inc., Arnold Air Force Station, Tenn.
CAPTURE COEFFICIENT OF 300°K CO_2 ON A 77°K SURFACE AS MEASURED BY THE ROTATING GAFE TECHNIQUE
T. L. Moody Arnold Eng. Develop. Center, Jan. 1967 22 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-231; AD-645510) CFSTI: HC $3.00/MF $0.65

The capture coefficient of 300K CO2 on a 77K surface is measured using a rotating gage measuring technique. It is concluded that the measured value is 0.99 plus or minus 0.01. However, the experimental data also indicate that the radiation load on the cryosurface may significantly affect the capture coefficient. Author (TAB)

N67-22758*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC SHIELDING
D. L. Waidelich *In its* 1966 Session of the Goddard Summer Workshop [1967] p 277–286 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

To reduce the effect of the earth's magnetic field for the testing of components and spacecraft in very low magnetic fields, a literature survey is presented on shielding against static magnetic fields. Some attention is devoted to shielding against low frequency fields as well. R.Li.

N67-22759*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PRODUCTION OF UNIFORM MAGNETIC FIELDS BY COMPENSATED SOLENOIDS
D. L. Waidelich *In its* 1966 Session of the Goddard Summer Workshop [1967] p 287–294 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

For application to the magnetic field testing of cylindrical objects such as sounding rocket or a long thin spacecraft, a longer and larger compensated solenoid was developed to produce a more uniform magnetic field. This brief literature review includes an extensive, annotated bibliography. R.Li.

N67-22762*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FOUR COIL SYSTEMS WITH A PROLATE VOLUME OF UNIFORMITY
John C. Morrison *In its* 1966 Session of the Goddard Summer Workshop [1967] p 311–319 ref (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

In relation to a study to produce the desired prolate volume in a modified power series, and for a symmetric system of four circular coils, the components of a magnetic fields are expressed as a series. The power series method is modified in order to extend the region of uniformity along the axis of the coils. Using this method, a particular solution is found having a length of 1 percent uniformity along the axis equal to 1.74 times the radius of the inner coils. This represents an improvement along the axis of 47 percent over the Braunbek solution presently used at the Goddard Magnetic Test Facility, with a corresponding loss in uniformity off axis. R.Li.

N67-22763*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DESIGN OF A SYSTEM OF EQUALLY SPACED, COAXIAL COILS TO PRODUCE A UNIFORM MAGNETIC FIELD
John C. Morrison *In its* 1966 Session of the Goddard Summer Workshop [1967] p 321–331 ref (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

For the design of magnetic fields with a prolate volume of uniformity, a system having a large number of equally-spaced, coaxial coils is investigated. An infinite system of circular coils is treated using Fourier analysis. A general method is described for selecting the spacing and radius of the coils to produce a given radius of uniformity of the magnetic field. The infinite system is then terminated, and a Fortran program is described which adjusts the current in the last three coils to minimize fringing effects. Finally, a particular numerical example is worked. R.Li.

N67-22767*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PRODUCTION OF UNIFORM GRADIENT MAGNETIC FIELDS
D. L. Waidelich *In its* 1966 Session of the Goddard Summer Workshop [1967] p 389–392 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

A brief literature survey outlines the production of uniform gradient magnetic fields in coil systems. A rather extensive annotated bibliography accompanies it. R.Li.

N67-22913 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
COLLIMATORS IN NEUTRON TIME-OF-FLIGHT POWDER DIFFRACTOMETRY [KOLIMATORY W DYFRAKTOMETRII PROSZKOWEJ METODA CZASU PRZELOTU NEUTRONOW]
A. Holas Sep. 1966 26 p refs
(INR-747/II/PS) CFSTI: HC $3.00/MF $0.65

The role of collimators in the time-of-flight neutron diffractometry is discussed. Special attention is paid to their contribution to intensity and resolution. The cases of limited width of a collimator and absorbing sample are considered separately. Author

N67-22933# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
RIGOROUS LOWER BOUND ON THE COMPRESSIBILITY OF A CLASSICAL SYSTEM
J. Ginibre Dec. 1966 5 p refs
(TH-179) CFSTI: HC $3.00/MF $0.65

A simple inequality is proven and applied to a system of classical particles enclosed in a box of volume V in ν dimensional Euclidean space, interacting through a two-body potential ϕ. The system is described in the grand canonical formalism and gives direct proof of the continuity of pressure as a function of density. K.W.

N67-22969 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
INTERDIFFUSION IN THE Zn–U SYSTEM [DYFUZJA WZAJEMNA URANU I CYNKU]
C. St. Gabrycki Sep. 1966 15 p refs In POLISH; ENGLISH summary
(INR-752/XIV/PS) CFSTI: HC $3.00

Diffusion layer growth in the interdiffusion in the Zn–U system was investigated in detail over the temperature range 205–400°C. The activation energy and coefficient K_0 were determined. Author

N67-23016# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
THE MICROTON: THEORY AND PRINCIPAL ELEMENTS OF THE PROJECT [IL MICROTRONE: TEORIA E PRINCIPALI ELEMENTI DI PROGRETTO]
D. Senatra 5 Oct. 1966 81 p refs In ITALIAN /ts Nota Interna No. 333
(LNF-66/45) CFSTI: HC $3.00/MF $0.65

The characteristics, operating principle, and application of the microtron, an electron particle accelerator, are briefly outlined in relation to a study of high-energy, high-intensity particle beams. A calculation is given on the stable phase, angular region in the case of large oscillations, and methods are illustrated of the accelerator electron injection. Also mentioned are electron motion in the cylindrical cavity, edge focusing, displacement matrix calculation, the microtron used as a positron accelerator, and electron motion in a cavity resonator. Transl. by R.U.

N67-23040 Royal Observatory, Edinburgh, Scotland
ON THE THEORY AND PRACTICE OF INSTRUMENTAL POLARIZATION
F. W. Jaeger and L. Oetken 1963 43 p refs Transl. into ENGLISH from the publ. of the Astrophys. Obs. at Potsdam (East Germany), v. 31, no. 103, pt. 1, 1963 CFSTI: $3.00

An analytical study was conducted to eliminate the influence of instrumental polarization on the measurement of polarization in astronomical sources. Definitions and transformations of the Stokes parameters are given, and the operation of special optical devices is investigated. An analysis of light affected by instrumental polarization is shown, and few numerical applications to circumstances in a two meter reflector are included. C.T.C.

N67-23088# Weapons Research Establishment, Salisbury (Australia).
CUT-OFF CHARACTERISTICS OF A CYLINDRICAL MAGNETRON
E. H. Hirsch Aug. 1966 23 p refs
(WRE-TN-CPD-118) CFSTI: HC $3.00/MF $0.65

The cut-off behavior of a cylindrical magnetron is investigated experimentally, and deviation from the predictions of the Hull theory is examined as a function of the operating conditions. The anomalous anode current beyond Hull cut-off is shown to be due to cooperative space charge effects, which cause electron flow both along and at right angles to the magnetic field. The axial distribution of anode current is found to be highly nonuniform, and the anomalous current is largely incident on the anode ends. Conventional two-dimensional theories of the magnetron therefore cannot adequately describe behavior beyond cut-off. Author

N67-23100# Rocket Propulsion Establishment, Westcott (England).
THE DERIVATION OF THE TRANSFER FUNCTION OF A SYSTEM FROM FREQUENCY RESPONSE DATA
A. J. Meade London, Min. of Aviation, Aug. 1966 39 p refs
(RPE-TR-66/9) CFSTI: HC $3.00/MF $0.65

A method is described whereby the transfer function of a system is derived from experimental frequency response data which have been obtained from tests on the system. The results and data are used to estimate the magnitude of errors in the calculated transfer function coefficients. A computer program using this theory has been written and some results using this program are given. Author

N67-23134# Norwegian Defence Research Establishment, Kjeller.
PROPOSED EXPERIMENTS FOR INVESTIGATING THE CHARACTERISTICS AND STABILITY OF ACOUSTIC TRANSMISSION PROPERTIES OF NORWEGIAN COASTAL WATERS
F. Bryn Aug. 1966 23 p refs
(Contract N62558-3732)
(U-191; Rept.-2526/66/NDRE/161; AD-645162) CFSTI: HC $3.00/MF $0.65

The report surveys briefly techniques for describing timevarying transmission channels and proposes a series of experiments for a preliminary investigation of the stability of acoustic transmission properties of Norwegian coastal waters. Author (TAB)

N67-23154# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
NOTE ON THE SOURCE LOCATION PROBLEM
Rex. P. Brumbach Dec. 1966 28 p refs
(Contract Nonr-4298(00); Proj. Vela Uniform)
(TR-66-82; AD-645814) CFSTI: HC $3.00/MF $0.65

The report contains a detailed, though not mathematically rigorous, discussion of the source location problem and its least squares solution for ray theoretic models. The deviation falls out quite naturally in a covariant form for spaces of arbitrary dimension. The presentation has been influenced by the presumption that numerical calculations will be carried out on a high-speed digital computer. No new results are presented; the note is intended to be of a didactic nature. Author (TAB)

N67-23413# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
CARBON DIOXIDE SPECTRAL LINE POSITIONS AND INTENSITIES CALCULATED FOR THE 2.05 AND 2.7 MICRON REGIONS
Robert F. Calfee and William S. Benedict (NBS) 15 Mar. 1966 113 p refs
(ARPA Order 250-61)
(NBS-TN-332) GPO: $0.60

The spectral line positions and intensities for the carbon dioxide bands occurring in the 2.05 and 2.7 micron regions of the infrared spectrum are listed. Lines with intensities down to 10^{-7} cm^{-1}/atm cm are listed for a temperature of 296°K. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-22064*# California Univ., Berkeley. Space Sciences Lab.
INVESTIGATION OF KILOVOLT ION SPUTTERING
Quarterly Progress Report, Nov. 1966–Jan. 1967

Harold P. Smith, Jr., F. C. Hurlbut, T. H. Pigford, Jhan Khan, and N. Thomas Olson 31 Jan. 1967 10 p ref
(Contract NAS3-5743)
(NASA-CR-72013, Ser. No. 8, Issue 6) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Continuing research in the interactions of ions and protons with material surfaces is summarized, including surface density measurements, velocity spectrum measurements, mercury ion sputtering, aluminum–aluminum oxide sputtering, and ion implantation. The proton–surface interactions studies constitute an investigation of the proton-induced characteristic oxygen X-rays as a possible surface analysis device for measuring oxygen contamination of material surfaces. L.E.W.

N67-22076*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UNUSUAL RESONANCE LINES OF HIGHLY IONIZED ATOMS OF THE FIRST LONG PERIOD
Uri Feldman and Leonard Cohen Feb. 1967 9 p refs
(NASA-TM-X-55737; X-614-67-112) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Resonance lines originating from energy levels far above the ionization potential have been observed for highly ionized atoms from Ti to Cu. Two of the lines for each ion have been classified as the transitions $2s^2\ 2p^6\ 3s\ {}^2S_{1/2}$–$2s^2\ 2p^5\ 3s^2\ {}^2P^0_{3/2,1/2}$ of the Na I isoelectronic sequence. Wavelengths and energy tables are given and a typical spectrogram is presented. Author

N67-22080*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEWLY IDENTIFIED LINES IN Ne I ISOELECTRONIC SEQUENCES
U. Feldman and L. Cohen Feb. 1967 9 p refs
(NASA-TM-X-55734; X-614-67-55) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Using a grazing-incidence spectrometer and a low inductance, 14μF, 12–17 kV, spark source, the spectra of Sc xii, Ti xiii, and V xiv have been observed. The lines have been identified as rising from transactions between the ground level $2s^2 2p^6\ {}^1S_0$ and the following electronic configurations: $2s\ 2p^6\ 3p$, and $2s^2\ 2p^5\ 4s$, 4d, 5d. The transitions of the type $2s^2\ 2p^6$–$2s^2\ 2p^5\ 4d$ have been observed also in Co xviii Ni xix and Cu xx. Author

N67-22101 United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.
ATOMIC AND MOLECULAR COLLISIONS
P. G. Burke 1967 305 p refs Lecture course at Princeton, Apr.–May, 1966
(AERE-L-170) HMSO: 36s

A lecture series on atomic and molecular collision processes is presented; emphasis is placed on theoretical developments. For individual titles, see N67-22102 through N67-22126.

N67-22102 United Kingdom Atomic Energy Authority, Harwell (England).
SCATTERING BY A SHORT RANGE CENTRAL FIELD. DEFINITION OF CROSS SECTION
In its Atomic and Molecular Collisions 1967 p 1–9 (See N67-22101 11-24) HMSO: 36s

The relative interaction of two particles (an electron with an atom) through a short range central field is described, and possible solutions of the equation describing the relative motion of the two particles for a variety of potentials in atomic scattering problems are analyzed. Focused on is a solution which satisfies an asymptotic boundary condition that represents an incident plane wave and an outgoing scattered wave. A time independent formalism is used to derive the scattering amplitude function which completely describes the scattering process. It is shown that knowledge of the scattering phase shift for all significant partial waves determines the scattering cross section. Threshold properties and the asymptotic behavior of the cross section are analyzed, and analytic properties of the partial wave amplitude are briefly discussed. S.C.W.

N67-22103 United Kingdom Atomic Energy Authority, Harwell (England).
PROPERTIES OF THE PHASE SHIFT. AN INTEGRAL EXPRESSION
In its Atomic and Molecular Collisions 1967 p 10–18 (See N67-22101 11-24) HMSO: 36s

Integral expressions for approximating phase shift and scattering amplitude are derived, and properties of the phase shift and scattering amplitude at low energies are analyzed. Considered are the effect of long range interactions which die off more slowly than an exponential. Included are examples of the long range polarization interaction which arises from the interaction of a charged particle with a neutral atom in a nondegenerate S state; and long range interactions due to a dipole. S.C.W.

N67-22104 United Kingdom Atomic Energy Authority, Harwell (England).
COULOMB EQUATION IN PARABOLIC COORDINATES
In its Atomic and Molecular Collisions 1967 p 19–29 (See N67-22101 11-24) HMSO: 36s

The method of parabolic coordinates is used to analyze the potential of long range Coulomb interactions. It is shown that both incident and scattered waves are distorted at infinite distances by logarithmic phase factors, and that the quantum mechanical and classical scattering results per pure Coulomb interactions are identical. It was further found that the Coulomb amplitude dominates the scattering at small angles corresponding to collisions at large distances while the modified amplitude takes over at large angles. The relationship between the quantum defect of the bound states and the scattering phase shift in a long range Coulomb interaction is also determined. The quantum defect formula is derived and used to analyze the S-wave scattering of an electron by a positive ion (Be^{+4}) of charge Z. The applicability of the method in determining the phase in the continuum region from the observed energy levels is demonstrated. A possible method for obtaining the continuum wave when the potential has a long range component, as for example, a polarization interaction as well as a Coulomb interaction, is constructed. S.C.W.

N67-22105 United Kingdom Atomic Energy Authority, Harwell (England).
THE BORN APPROXIMATION
In its Atomic and Molecular Collisions 1967 p 30–43 (See N67-22010 11-24) HMSO: 36s

The Born approximation for deriving an expression for the total scattering amplitude, and remarks on the convergence of the Born series; are presented. It is shown that the Born expansion converges only in special circumstances and general results are given which indicate the regions of validity of the Born approximation. Several variational principles satisfied by continuum wave functions which are also of importance in scattering problems are analyzed. Also considered is the possibility of developing minimum principles in scattering and their extension to complex systems. S.C.W.

N67-22106 United Kingdom Atomic Energy Authority, Harwell (England).
STATIC APPROXIMATION IN e^-–H SCATTERING
In its Atomic and Molecular Collisions 1967 p 44–55 (See N67-22101 11-24) HMSO: 36s

Analyzed are several applications of theories and methods for approximating the properties of scattering cross sections due to a potential interaction U(r). To demonstrate how approximations to this potential can be obtained, the so-called one state or static approximation with and without exchange for electron scattering by atomic hydrogen is considered. It is shown that exchange plays a fundamental role for the low energy scattering while at higher energies the no-exchange result tends toward the average of the singlet and triplet scattering. An analysis of the low energy phase shift behavior of helium and neon; and the Ramsauer–Townsend effect in argon krypton, and xenon; is also presented. Included is a description of a method for analyzing atomic polarizability. S.C.W.

N67-22107 United Kingdom Atomic Energy Authority, Harwell (England).
SCATTERING BY A COMPLEX ATOM. DEFINITION OF A CHANNEL
In its Atomic and Molecular Collisions 1967 p 56–65 (See N67-22101 11-24) HMSO: 36s

Developed is a method for deriving approximations which describe the scattering of electrons by complex atoms. The proposed method involves the solution of a set of coupled integro-differential equations, one for each final asymptotic state, or channel into which the system can decay; and the use of coupled differential equations for analyzing channels which are energetically inaccessible. S.C.W.

N67-22108 United Kingdom Atomic Energy Authority, Harwell (England).
RADIAL EQUATIONS FOR e^-–H SCATTERING
In its Atomic and Molecular Collisions 1967 p 79–90 (See N67-22101 11-24) HMSO: 36s

Presented is an analysis of the theory for describing scattering by complex atoms. Analyzed are radial equations for approximating elastic and inelastic electron scattering by atomic hydrogen; scattering by hydrogen-like ions; and scattering between ground configuration terms in $2p^q$ atoms. S.C.W.

N67-22109 United Kingdom Atomic Energy Authority, Harwell (England).
BORN APPROXIMATION FOR EXCITATION
In its Atomic and Molecular Collisions 1967 p 79–90 (See N67-22101 11-24) HMSO: 36s

Presented is an analysis of the partial wave born approximation for analyzing the excitation behavior of electrons with hydrogen atoms at high energies; the Bethe approximation for atoms and ions; Bethe surfaces and stopping power; and an approximation method for extending the validity of the Born approximation of lower energies. S.C.W.

N67-22110 United Kingdom Atomic Energy Authority, Harwell (England).
ELECTRON EXCHANGE AND SYMMETRIC WAVE FUNCTIONS
In its Atomic and Molecular Collisions 1967 p 91–99 (See N67-22101 11-24) HMSO: 36s

The general theory of electron exchange and approximations for determining its contribution to the total amplitude are analyzed. It is shown that given an asymmetric solution to a two electron Hamiltonian, two independent solutions having definite symmetry properties can be defined. It is further shown that for bound states, solutions with maximum symmetry are the required eigenstates of hydrogen independent of Pauli's principle; and for continuum levels, solutions with or without symmetry properties can be used. The importance of exchange effects in elastic e^-–H is analyzed. The Born–Oppenheimer approximation and the Ochkur approximation are also analyzed. S.C.W.

N67-22111 United Kingdom Atomic Energy Authority, Harwell (England).
DEFINITION OF DIRECT AND EXCHANGE IONIZATION AMPLITUDES
In its Atomic and Molecular Collisions 1967 p 100–109 (See N67-22101 11-24) HMSO: 36s

Equations are derived for defining direct and exchange ionization amplitudes. Using Jeffries stationary phase theorem it is shown that these two amplitudes describe the same physical process and have the same phase. Integral expressions for deriving the ionization amplitudes are presented and several approximation methods for evaluating the ionization cross section are analyzed. Considered are the Born approximation; the Born–Oppenheimer approximation; the distorted wave Born-Oppenheimer approximation; the Born–Exchange approximation; and the Ochkur approximation. Results for hydrogen ionization from the 1s state which were obtained using these approximations are analyzed. It is shown that the Ochkur approximation gives the best results. Laws for determining the behavior of the threshold cross section are also examined. S.C.W.

N67-22112 United Kingdom Atomic Energy Authority, Harwell (England).
CLASSICAL SCATTERING BY A COULOMB FIELD
In its Atomic and Molecular Collisions 1967 p 110–120 (See N67-22101 11-24) HMSO: 36s

The classical theory for calculating the scattering cross section for two particles interacting through a Coulomb potential is examined. Analyzed are attempts by Thompson and Gryzinski to apply this theory to collisions of electrons by atoms. It is shown that Gryzinski's theory together with a further approximation in carrying out relevant integrals is in good agreement with experimental calculations of ionization in the intermediate energy range. The classical theory for calculating the excitation cross section is also examined. It is shown that excitation does not have such a well defined meaning classically as does ionization; and that it is not easy to distinguish excitation to different degenerate levels such as those occuring in hydrogen with different l but the same n. Additional refinements of the classical theory and classical experimental results for heavy particle collisions are also considered. S.C.W.

N67-22113 United Kingdom Atomic Energy Authority, Harwell (England).
THE TRANSITION AMPLITUDE
In its Atomic and Molecular Collisions 1967 p 121–131 (See N67-22101 11-24) HMSO: 36s

The distorted wave approximation which allows for the distortion of scattered waves both in the initial and final states is derived using the transition amplitude, and applications of methods by Vainshtein, Presnyakov, and Sobelman and by Crowthers and McCarroll to electron excitation of atoms are analyzed. It is shown that the approach proposed by Caunshtein et al yields a cross section in agreement with experiment which has considerably lower energies than the Born approximation; and that results of Crowthers and McCarroll give experimentally observed features of a dip in the cross section at intermediate energies. The method is similar to the classical impulse method in that the electron-electron term is treated exactly. An alternate method (dipole method) for calculating excitation cross sections based upon a semiclassical impact parameter method is also examined. S.C.W.

N67-22114 United Kingdom Atomic Energy Authority, Harwell (England).
MINIMUM PRINCIPLE IN MANY CHANNEL SCATTERING
In its Atomic and Molecular Collisions 1967 p 132–141 (See N67-22101 11-24) HMSO: 36s

The Feshbach projection operator formalism is used to equate the relationship between the minimum principle and the occurrence

of resonances close to but slightly below thresholds. It is shown that there is a close connection between minimum principles and resonances which arise in atomic scattering when the energy of the incident particle is not sufficient to excite a new channel; and that the inclusion of closed channels in the scattering equations produces an additional attractive force which increases the eigenphases and in certain circumstances may be strong enough to introduce resonances in the scattering. Recent research on minimum principles in scattering is cited. S.C.W.

N67-22115 United Kingdom Atomic Energy Authority, Harwell (England).
EXPERIMENTAL EXAMPLES OF ATOMIC AND MOLECULAR RESONANCE REACTIONS
In its Atomic and Molecular Collisions 1967 p 142–154 (See N67-22101 11-24) HMSO: 36s

Experimental examples of atomic and molecular resonance reactions are presented and the applicability of experimental results to the proposed formal theory of resonance reactions is analyzed. A generalized effective range expansion for short range forces which is valid when many channels are strongly coupled is derived and used to analyze the case of two channel scattering. Modifications due to long range forces ($e^- - H$ scattering) are also considered. S.C.W.

N67-22116 United Kingdom Atomic Energy Authority, Harwell (England).
EFFECTIVE RANGE FORMULA FOR DEGENERATE DIPOLE COUPLING
In its Atomic and Molecular Collisions 1967 p 155–163 (See N67-22101 11-24) HMSO: 36s

A modified effective range formula is derived and used to analyze degenerate dipole coupling. The applicability of this method to $e^- - H$ scattering, coupled channels with Coulomb interaction, and two channels, is examined. S.C.W.

N67-22117 United Kingdom Atomic Energy Authority, Harwell (England).
CONFIGURATION INTERACTION APPROACH TO RESONANCES
In its Atomic and Molecular Collisions 1967 p 164–179 (See N67-22101 11-24) HMSO: 36s

An alternative model for describing resonant or autoionizing states is considered. The proposed method takes, as a zeroth order approximation states, a number of discrete states interacting with a number of continua. The Hamiltonian matrix is then diagonalized to yield the final wave function for the system. Analyzed are methods for evaluating resonance widths; photoabsorption and line shapes for resonance continua; and interactions with many continua. S.C.W.

N67-22118 United Kingdom Atomic Energy Authority, Harwell (England).
INTRODUCTION TO ELECTRON-MOLECULE SCATTERING
In its Atomic and Molecular Collisions 1967 p 180–189 (See N67-22101 11-24) HMSO: 36s

An introduction to the general theory of electron-molecule scattering which considers the Born–Oppenheimer approximation method, the Frank–Condon principle, expansion in molecular eigenstates, elastic scattering, and rotational and vibrational excitation; is reported. S.C.W.

N67-22119 United Kingdom Atomic Energy Authority, Harwell (England).
SCATTERING OF FAST ELECTRONS BY MOLECULES. ATOMIC INTERFERENCE EFFECTS
In its Atomic and Molecular Collisions 1967 p 190–197 (See N67-22101 11-24) HMSO: 36s

The following simplifications are considered for the case of the collision of fast electrons with molecules: (1) For collisions such that the wave length of the incident beam is less than the atomic separation in the molecule, the atoms in the molecule can be treated as independent scattering centers. (2) If multiple scattering is negligible as it would be at high energies, the total amplitude may be obtained by adding the individually scattered waves with the appropriate phase differences. (3) At high energies, the Born-approximation amplitude can be used for the atomic scattering. Analyzed is the applicability of the Born approximation to $e^- - H_2^+$ dissociation; and methods used to determine elastic scattering of slow electrons by molecules. S.C.W.

N67-22120 United Kingdom Atomic Energy Authority, Harwell (England).
ROTATIONAL EXCITATION OF MOLECULES BY SLOW ELECTRONS. THE GERJUOY–STEIN THEORY
In its Atomic and Molecular Collisions 1967 p 198–205 (See N67-22101 11-24) HMSO: 36s

The Gerjuoy–Stein theory for determining energy losses in molecular gases which are induced by excitation of molecular rotation and vibration is analyzed. Focused upon is the applicability of the theory to electron scattering by hydrogen and nitrogen. Sources of inaccuracy in the theory are considered and methods for their correction are examined. The general theory of rotational excitation introduced by Arthurs and Dalgarno is used to evaluate the effects of molecular polarizability and the validity of the Born approximation; and a procedure for analyzing short range forces is developed. It is concluded that, as an energy loss mechanism, rotational excitation is dominated by elastic scattering by the Coulomb interaction which is most important at low energies. S.C.W.

N67-22121 United Kingdom Atomic Energy Authority, Harwell (England).
ROTATIONAL EXCITATION OF POLAR MOLECULES BY SLOW ELECTRONS
In its Atomic and Molecular Collisions 1967 p 206–214 (See N67-22101 11-24) HMSO: 36s

Theoretical analyses of the excitation of individual rotational levels in polar molecules; vibrational excitation in molecules by slow electron impact; and dissociative electron capture by molecules; are presented. S.C.W.

N67-22122 United Kingdom Atomic Energy Authority, Harwell (England).
INTRODUCTION TO CHARGE EXCHANGE SCATTERING
In its Atomic and Molecular Collisions 1967 p 215–223 (See N67-22101 11-24) HMSO: 36s

Presented is an analysis of charge exchange reactions at high energies which considers results obtained using the Brinkman Kramers theory, the Born approximation, the Second Born approximation, and the impulse approximation of Chew. S.C.W.

N67-22123 United Kingdom Atomic Energy Authority, Harwell (England).
THE BATES METHOD FOR CHARGE EXCHANGE BY EXPANDING IN ATOMIC EIGENSTATES
In its Atomic and Molecular Collisions 1967 p 224–233 (See N67-22101 11-24) HMSO: 36s

Presented is an analysis of a theory of charge exchange developed by Bates which is valid at energies lower than the Born approximation or its variants. The method is somewhat equivalent to the close coupling expansion for electron atom scattering; and except at very low energies, the impact parameter

method (in which the heavy particles are assumed to follow classical paths) and the wave treatment are equivalent. The applicability of the method in deriving coupled equations is illustrated and solutions for $H-H^+$ scattering are analyzed. Included is a discussion of recent classical theories of electron capture. S.C.W.

N67-22124 United Kingdom Atomic Energy Authority, Harwell (England).
INTRODUCTION TO ATOM-ATOM COLLISIONS. A CLASSICAL FORMULA
In its Atomic and Molecular Collisions 1967 p 234–243 (See N67-22101 11-24) HMSO: 36s

A classical path method for analyzing elastic scattering between two heavy particles is described and the applicability of the method in deriving differential and total cross sections is examined. Rainbow scattering and Glory scattering; and orbiting and ion-molecule interactions are considered to illustrate the possibility of quantum mechanical interference effects. Also discussed is a theory of ion molecule interactions. S.C.W.

N67-22125 United Kingdom Atomic Energy Authority, Harwell (England).
MULTIPOLE EXPANSION OF THE ATOM–ATOM INTERACTION
In its Atomic and Molecular Collisions 1967 p 244–252 (See N67-22101 11-24) HMSO: 36s

Presented is an analysis of the theory of slow inelastic collisions between atomic systems which focuses on the molecular orbital expansion method and its applicability to resonant charge transfer. Also analyzed are inelastic effects in atom–atom collisions, the Landau–Zener formula, and results for inelastic atom–atom processes. S.C.W.

N67-22126 United Kingdom Atomic Energy Authority, Harwell (England).
MOLECULAR ORBITAL EXPANSION FOR ATOM-ATOM COLLISIONS
In its Atomic and Molecular Collisions 1967 p 253–263 (See N67-22101 11-24) HMSO: 36s

Methods which have been used to estimate the interactions between two atomic systems are analyzed and collisions between atomic systems are discussed from a quantum mechanical point of view. Considered are interactions between two hydrogen atoms and interactions between rare gas atoms; and the applicability of existing theories to atom-atom and atom-molecule collisions. S.C.W.

N67-22130# California Univ., Livermore. Lawrence Radiation Lab.
PHYSICS DEPARTMENT PROGRESS REPORT, OCTOBER 1965-JANUARY 1966
Jan. 1966 55 p refs
(UCRL-14744) CFSTI: HC $3.00/MF $0.65

CONTENTS:
1. NUCLEAR AND ATOMIC PHYSICS p 1–18 refs (See N67-22131 11-24)
2. THERMODYNAMIC PROPERTIES OF MATTER p 19–36 refs (See N67-22132 11-26)
3. RADIATION AND PLASMA PHYSICS p 37–48 refs (See N67-22133 11-25)

N67-22131# California Univ., Livermore. Lawrence Radiation Lab.
NUCLEAR AND ATOMIC PHYSICS
In its Phys. Dept. Progr. Rept. Jan. 1966 p 1–18 refs (See N67-22130 11-24) CFSTI: HC $3.00/MF $0.65

A report is presented on the theoretical and experimental aspects of nuclear and atomic physics. Topics discussed are Lehmann–Symonzik–Zimmermann (LSZ) formalism in the Lee model (V–θ Sector), equivalent field theories and elementary particle democracy, strong interactions in the Limit $Z_3 = 0$, Gell–Mann Okubo Rule as a consequence of eightfoldedness, symmetries in first approximation S-matrix theory, helium inter-molecular potential, analysis of $^{13}_{\Lambda}C$, shape of fission barrier for ^{242}Am, X-ray production in the L shell of copper by 25 to 1700 KeV protons, fission cross sections of ^{235}U, excitation of the ground-state band of ^{19}F by 13.9 MeV proton scattering, quasi-elastic (p,n) scattering from scandium and titanium isotopes, excited states in ^{8}Be, high resolution studies of fission X-rays and gamma rays, neutron diffraction-sodium superoxide, shell model calculations, and fitting of various (p,n) cross sections via the LOKI 2A Code. NSA

N67-22135# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
VIBRATIONAL DISSOCIATION AND CASCADE DISSOCIATION OF H_2+ IONS BY COLLISION WITH MOLECULES OF A GAS [DISSOCIATION VIBRATIONNELLE ET DISSOCIATION EN CASCADE D'IONS H_2+ PAR COLLISIONS AVEC LES MOLECULES D'UN GAZ]
P. Verveer (Ph. D. Thesis) 1966 61 p refs In FRENCH
(Contract EURATOM-007-62-1 FUAF)
(CEA-R-2983; EUR-2767.f) CFSTI: HC $3.00/MF $0.65

The fine structure of the energy spectra of protons produced by H_2^+ ion molecules is considered in a study of the various processes of dissociation, especially dissociation by excitation of nuclear vibrations. By increasing the 0.4% power of resolution of the experimental system, it is possible to observe the structure in greater detail. It was concluded that better stability of the high acceleration tension of ions is necessary to obtain more precise measurements of sections of vibrational dissociation, as well as to normalize functioning conditions in the ion source.
Transl. by R.U.

N67-22311# California Univ., Livermore. Lawrence Radiation Lab.
COLLISION-INDUCED MIXING IN THE $5^2P_{3/2}$ STATE OF RUBIDIUM AND THE $6^2P_{3/2}$ STATE OF CESIUM
Joseph Yellin 4 Oct. 1966 15 p refs
(Contract W-7405-ENG-48)
(UCRL-17175) CFSTI: HC $3.00/MF $0.65

Alkali–metal vapors of rubidium and cesium were optically pumped, with the D_2 component of the resonance radiation and the reversal of the ground-state polarization observed as a function of buffer-gas pressure. It is well known that when complete mixing occurs in the $^2P_{3/2}$ state, the polarization achieved in the ground state ($^2S_{1/2}$) is opposite to that obtained with the D_1 component of the resonance radiation when circularly polarized light is used. However, in the absence of mixing in the $^2P_{3/2}$ state, the sign of the polarization is the same for both D_1 and D_2 light. For some finite degree of mixing of the $^2P_{3/2}$ state, the equilibrium electronic polarization vanishes. From the null points observed in the D_2 pumping signal vs buffer-gas-pressure curve, cross sections were determined for collisional disorientation of the $^2P_{3/2}$ state of a polarized Rb or Cs atom. Author (NSA)

N67-22313# Los Alamos Scientific Lab., N. Mex.
FISSION CROSS SECTIONS FROM PETREL
9 Dec. 1966 231 p refs
(Contract W-7405-ENG-36)
(LA-3586) CFSTI: HC $3.00/MF $0.65

Fission data obtained in the Petrel event of June 11, 1965, are presented graphically and in tables, including calculated standard deviations. The isotopes studied were ^{233}U, ^{235}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, and ^{242}Am; the neutron energy range covered for most isotopes was 20 eV to 1 MeV. Author (NSA)

N67-22317# California Univ., Livermore. Lawrence Radiation Lab.

BETA-GAMMA (CIRCULARLY POLARIZED) CORRELATION AND GAMMA SPECTROSCOPIC STUDIES ON Mg^{27}

Robert A. Bigoni (Ph.D. Thesis) 18 Jul. 1966 35 p refs

(Contract W-7405-ENG-48)

(UCRL-14984) CFSTI: HC$3.00/MF$0.65

Studies were made of the circular polarization of the two high-energy γ rays (1.01 MeV and 0.84 MeV) following the two-branch β^- decay of ^{27}Mg to ^{27}Al. The photon's (i.e., γ-ray's) spin polarization is a result of its being detected in coincidence with an immediately preceding β particle which possesses, in the relativistic limit, 100% longitudinal polarization (transferred in part to the γ ray) by virtue of the complete breakdown of parity in β decay. The γ-ray polarization measurements were done with γ polarimeters based on the principle of the dependence of the Compton-scattering cross section on the relative orientation of electron spin and photon spin. The γ polarimeters were geometrical configurations of magnetized iron which provided collections of partially aligned electrons from which the γ rays could Compton-scatter. A computer calculation of the detection efficiency of one of these configurations (two were utilized in the present work) was necessary in order to separate the effects due to the two γ rays of principal interest in this investigation. The polarimeter results for the two γ rays of concern are given, as usual, in terms of an asymmetry parameter, A, which gives the photon polarization when the angle between the photon and its coincident β-particle is 0°. In addition, a spectroscopic study of all three γ rays (1.01-, 0.84-, and 0.175-MeV) involved in this decay was made using a lithium-drifted germanium detector in conjunction with standard techniques of multichannel pulse–height analysis. Author (NSA)

N67-22320# Argonne National Lab., Ill.

ARGONNE NATIONAL LABORATORY PHYSICS DIVISION SUMMARY REPORT, JUNE–AUGUST 1966

Aug. 1966 61 p refs

(Contract W-31-109-ENG-38)

(ANL-7247) CFSTI: HC$3.00/MF$0.65

Neutron angular distributions and polarizations in neutron scattering by ^{19}F at energies between 0.2 and 2.2 MeV were measured. The data are consistent with the interpretation of the observed intermediate structure in terms of doorway states and lead to an assignment of spins and parities to these states. Using the metastable 8^- state as an example, it was also demonstrated that nuclear systematics in deformed nuclei can sometimes be used to set an upper limit on possible parity mixing. A mass spectrometer was used to study the photoionization of alcohols, alkanes, high-temperature vapors, and the CF_3 and CH_3 radicals. The reactions of H_2^+ and O_2^+ with He and H_2 were also studied using photoexcitation of different electronic and vibrational states of the reacting ions. NSA

N67-22387# Argonne National Lab., Ill.

MACH 1, A ONE-DIMENSIONAL DIFFUSION-THEORY PACKAGE

D. A. Meneley, L. C. Kvitek, and D. M. O'Shea Jun. 1966 71 p refs

(Contract W-31-109-ENG-38)

(ANL-7223) CFSTI: HC$3.00/MF$0.65

A computer program, MACH 1, for single-step calculations of reactor parameters is described. The program solves the coupled set of one-dimensional multigroup diffusion equations in cylindrical, slab, or spherical coordinates. The program is written in FORTRAN for the CDC-3600 computer with 64-K core storage. NSA

N67-22443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INTERACTION OF NEUTRONS WITH URANIUM-235 NUCLEI IN THE ENERGY REGION OF 0.002–30 KeV

Shih-Ti Wang, Yung-ch'ang Wang et al 12 Sep. 1966 22 p refs Transl. into ENGLISH from Russian

(FTD-HT-66-338; TT-67-60265; AD-643958) CFSTI: HC $3.00/MF$0.65

Work is described which used a new experimental method to investigate the interaction of neutrons with U-235 nuclei in the region 0.002-30 kev to obtain the parameters of the levels and to determine the average cross sections of fission and radiation capture. Author (TAB)

N67-22458# Oak Ridge National Lab., Tenn.

PREPARATION OF PHOSPHORUS-33 BY IRRADIATION OF ENRICHED SULFUR-33 IN HIGHLY THERMALIZED FLUX

R. E. Lewis and S. A. Reynolds Jan. 1967 7 p refs

(Contract W-7405-ENG-26)

(ORNL-4051) CFSTI: HC$3.00/MF$0.65

Millicurie quantities of carrier-free ^{33}P containing <1% ^{32}P were prepared by neutron irradiation of enriched sulfur targets (61.15 and 68.1% ^{33}S) in a highly thermalized neutron flux. Target irradiation conditions and radionuclide yields are given, and the chemical recovery procedure and analytical methods are described. Author (NSA)

N67-22464# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

ISOTOPIC SPIN ANALYSIS OF POSSIBLE CP VIOLATING EFFECTS IN $K \rightarrow 3\pi$

M. K. Gaillard Jan. 1967 17 p refs

(Th-181) CFSTI: HC$3.00/MF$0.65

Charge-parity violating effects in the decay $K \rightarrow 3\pi$ are analyzed in terms of isotopic spin parameters. In particular, the interference term between K_S and K_L amplitudes, and the difference in partial rates in $K^\pm$ decay are considered. In general, the real part of the interference terms is expected to be much smaller than the imaginary part for transitions with $|\Delta I| < 5/2$. The success of the $|\Delta I| = 1/2$ rule in K_L- and K^+-decay sets an upper limit on the imaginary part of the interference term for CP violating amplitudes with $|\Delta I| = 1/2$. This limit is probably too high to be useful, but a significant effect in the real part would probably indicate that amplitudes with $|\Delta I| > 1/2$ are important. This conclusion could be checked by comparing the real part of the interference term with the differences in partial rates in $K^\pm$ decay; the two effects are directly related through coefficients depending on $|\Delta I|$ and the isotopic spin of the final state. In K^0 decay, I=1 final states ($|\Delta I| < 5/2$) may be distinguished from I=3 final states ($|\Delta I| \geq 5/2$) by comparing the imaginary parts of the interference terms in the $\pi^+\pi^-\pi^0$ and the $3\pi^0$ modes. Author

N67-22478# Nihon Univ., Tokyo (Japan).

ON NONLEPTONIC DECAYS: INTERRELATION AMONG VARIOUS TYPES OF EFFECTIVE WEAK INTERACTIONS

Kanji Fujii (Tokyo Univ.), Mitsuo Imoto, Shoichiro Kawasaki (Chiba Univ.), Shin-ya Furui, Tetsuya Tsuchida (Ibaraki Univ.) et al 7 Jan. 1967 52 p refs

(INS-104) CFSTI: HC$3.00/MF$0.65

Interrelation among effective weak Yukawa interactions and various types of two-body weak interactions is discussed, and the refinement of the pole approximation is given. One assumption investigated leads to the soft meson theorem, owing to which one can relate the strong scattering amplitudes (the strong vertices) to the weak vertices (the effective two-body weak interactions), and octet-spurion formalism and tadpole model are derived. The decouplet-baryon pole contributions to the hyperon decays are estimated, and are shown to be small. The relation of the weak interaction Hamiltonian to the scalar and pseudoscalar densities is also discussed. It is shown first that as far as the matrix elements between one-particle states is concerned, the interaction can be regarded as approximately proportional to the scalar and pseudoscalar densities with appropriate SU(3) transformation

properties, and secondly that one can obtain favorable values for the ratios of coupling constants of the effective two-body weak interaction. Author

N67-22478# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MEASUREMENT OF NEUTRON FLUENCE BY FISSION FRAGMENT DAMAGE TRACK DETECTION
R. C. Bhatt Aug. 1966 31 p refs
(AECL-2657) CFSTI: HC $3.00/MF $0.65

The phenomenon of fission-fragment damage produced in glass and mica was studied for its possible application in the measurement of neutron fluence. Experiments with three detectors systems employing natural uranium foil in conjunction with mica, phosphate glass, and silicate glass, are described. The thermal neutron sensitivity of each of the above systems is estimated from standardization experiments with thermal neutrons. Neutron sensitivities of a number of detector systems at various neutron energies of interest are predicted with the help of corresponding fission cross-section data. Applications to personnel neutron dosimetry are discussed. Author

N67-22480# Nihon Univ., Tokyo (Japan).
ON THE QUASISPIN FORMALISM
Munetake Ichimura 1966 79 p refs Submitted for publication
(NUP-66-16) CFSTI: HC $3.00/MF $0.65

A complete formulation of the quasispin technique is developed. The quasispin formalism for an identical nucleon system is reviewed as a model case. The quasispin formalism for proton–neutron system (the five-dimensional quasispin) is developed in analogy with the model case as far as possible. Some useful formulas for coefficients of fractional parentage (c.f.p.'s), transition matrix elements, and interaction energy matrix elements are obtained both for identical nucleon system and for proton–neutron system. The new classification of states and operators is presented. The general theory of the quasispin formalism which is applicable to many different kinds of pair correlations is also given. Author

N67-22481# International Centre for Theoretical Physics, Trieste (Italy).
THE UNITARY REPRESENTATIONS OF THE SIMILITUDE GROUP OF SPACE–TIME
R. L. Ingraham (New Mexico State Univ.) Feb. 1967 34 p refs Submitted for publication
IC-67/7) CFSTI: HC $3.00/MF $0.65

CONTENTS:
1. PART I p 1–16 refs (See N67-22482 11-24)
2. PART 2: NEW FORMULATION OF THE BARGMANN–WIGNER ANALYSIS; EXPLICIT CONSTRUCTION OF WIGNER'S SPIN MATRICES $Q(k,\alpha\Lambda)$ p 17–31 refs (See N67-22483 11-24)

N67-22482# International Centre for Theoretical Physics, Trieste (Italy).
THE UNITARY REPRESENTATIONS OF THE SIMILITUDE GROUP OF SPACE–TIME. PART I
In its Unitary Representations of the Similitude Group of Space–Time Feb. 1967 p 1–16 refs (See N67-22481 11-24)
CFSTI: HC $3.00/MF $0.65

All the unitary representations of the space–time similitude group S (Poincare group P plus uniform dilatations Δ, are classified following Wigner's method and should be physically interesting because Δ has been argued elsehwere and can be physically interpreted as the group of changes of length unit, whence the 11-parameter S is the actual kinematical symmetry group of present-day relativistic physics. It is proved that the extension of P to S gives essentially no new elementary particle structure, i.e., no new quantum numbers beyond these of P. Author (ESRO)

N67-22483# International Centre for Theoretical Physics, Trieste (Italy).
THE UNITARY REPRESENTATIONS OF THE SIMILITUDE GROUP OF SPACE–TIME. PART II: NEW FORMULATION OF THE BARGMANN–WIGNER ANALYSIS—EXPLICIT CONSTRUCTION OF WIGNER'S SPIN MATRICES $Q(k,\lambda)$
In its Unitary Representations of the Similitude Group of Space–Time Feb. 1967 p 17–31 refs (See N67-22481 11-24)
CFSTI: HC $3.00/MF $0.65

The Bargmann–Wigner theory for the similitude group is rephrased in terms of projection operators, which facilitates the proof of unitarity and the explicit construction of the 'spin part' $Q(k,\alpha\Lambda)$ which appears in the formula of Part 1 for the most general unitary representation. The infinitesimal (Lie algebra) approach is inessential for this purpose, and finite transformations are used instead. Author (ESRO)

N67-22484# International Center for Theoretical Physics, Trieste (Italy).
SEPARABLE NON-LOCAL TWO-NUCLEON POTENTIAL FOR ODD-PARITY SPIN TRIPLET STATES
J. H. Naqvi (Aligarth Muslim Univ.) Dec. 1965 25 p refs Submitted for publication
(IC/66/121) CFSTI: HC $3.00/MF $0.65

A separable non-local two-nucleon potential for spin triplet odd parity states is presented which reproduces the YLAM phase parameters up to about 320 MeV. The potential is taken to be effective in l = 1, 3, and 5 states only; and essentially consists of L-dependent central, tensor, linear and quadratic spin-orbit parts. Author (ESRO)

N67-22501# International Center for Theoretical Physics, Trieste (Italy).
SU_3 WIGNER COEFFICIENTS IN ANGULAR MOMENTUM SPACE
M. Iosifescu and F. Stancu (Academia R. P. R.) Dec. 1966 19 p refs Submitted for publication
(IC/66/108) CFSTI: HC $3.00/MF $0.65

SU_3 Wigner coefficients for the decoupling $(\lambda l) = (\lambda'\mu') \times (\lambda''\mu'')$ and $(\lambda o) = (\lambda'\mu') \times (\lambda''\mu'')$ with $(\lambda''\mu'') = (2,0)$; have been obtained using basic functions of given angular momentum. Author (ESRO)

N67-22528# Illinois Univ., Urbana.
EXPOSURE FIELD FROM A POINT ISOTROPIC SOURCE LOCATED AT THE SURFACE OF A THICK CONCRETE SLAB Final Report
A. B. Chilton and C. Y. Fu Aug. 1966 64 p refs
(Contract OCD-OS-63-66)
(Rept.-2; AD-637125) CFSTI: HC $3.00/MF $0.65

This report gives results of computations for the exposure field from point isotropic sources of cobalt-60 and cesium-137 near the surface of a semi-infinite concrete slab. A modification of the Chilton–Huddleston differential albedo formula developed for the vacuum/concrete interface situation is used. To modify the results to include the air effect, computation was made to account for the single-scattered contribution. The higher order air scattering contribution, which is smaller, was estimated approximately from infinte buildup factors in air. The final results, with horizontal source-detector distances out to 50 feet, are presented in comparison with various experimental results. The computational results are estimated to have an uncertainty of about 1%. Agreement with previous work is good in some cases, but under some conditions appreciable discrepancies exist. The preponderance of evidence supports the theoretical results and they are recommended for future use. Author (TAB)

N67-22645# University of Southern Calif., Los Angeles. School of Engineering.
ROTATIONAL TEMPERATURE MEASUREMENTS IN NITROGEN USING AN ELECTRON BEAM
Roy Scott Hickman Sep. 1966 31 p refs
(Grant AF-AFOSR-697-66)
(USCAE-104; AFOSR-66-2509; AD-645113) CFSTI: HC $3.00/MF $0.65

The models used for determination of the rotational temperature from the spectra of fluorescence of nitrogen induced by collisions with electrons are reviewed and discussed. It was found necessary to introduce a new model which is a composite of two processes and allows rotational changes of delta K of plus or minus 1 and plus or minus 3 to obtain agreement with temperatures obtained in rarefied flows of nitrogen. Data is presented for a flow of nitrogen in a nozzle and an overexpanded sonic orifice flow. It is shown that the data reduced with the new model agrees with the predicted translational temperature to within the characteristic rotational temperature and can be used to measure the rotational temperature at low temperatures. Author (TAB)

N67-22642*# Massachusetts Inst. of Tech., Cambridge.
MOLECULAR BEAMS
J. R. Zacharias, K. W. Billman, J. G. King, C. L. Searle, K. Fokkens et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 1–11 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

A brief outline is given of research objectives in the field of molecular beams related to rf spectra, atomic clocks, and null experiments; research with low-temperature atomic beams; and development of a molecular microscope. The method of square-wave phase modulation is discussed, and results are given that were obtained using a cesium beam magnetic resonance apparatus with 125-cm separation to test the square-wave phase-modulation system as well as values obtained for parameters in the theoretical expression for the resonance function. Details are given on a search for a shift in the transverse electromagnetic mass of the electron, which was made using a cesium atomic clock of the usual separated cavity type. L.E.W.

N67-22644*# Massachusetts Inst. of Tech., Cambridge.
ATOMIC RESONANCE AND SCATTERING
D. Kleppner, M. T. Myint, I. Ozier, C. Burnham, D. E. Prichard et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 27–30 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Resonance experiments conducted to determine the magnetic moment of the proton are discussed. A hydrogen maser was used which permitted a determination of the proton g-factor in atomic hydrogen. Scattering efforts, concerned with studying the interactions of atoms with ions, atoms, and electrons, as revealed by the electron-spin exchange, are described. A summary of the experiments that are being considered is presented in tabular form. Author

N67-22649*# Massachusetts Inst. of Tech., Cambridge.
GRAVITATION RESEARCH
R. Weiss, S. Ezekiel, and G. D. Blum *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 69–73 ref (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Two experimental approaches to determining the consequences of a scalar gravitational interaction are described briefly. Consideration is given to an experimental test of the Freundlich photon–photon scattering hypothesis using a laser interferometer sensitive to 5×10^{-9} of a fringe shift. Finally, descriptions are given of measurements of metastable vs ground-state electron exchange cross sections for helium and neon. The atomic beam apparatus used is depicted, and illustrations are given of typical detector data obtained with helium and neon metastables. The cross sections were found to be 6.8×10^{-15} cm^2 for helium and 1.6×10^{-14} cm^2 for neon. The peak number of metastables leaving the discharge tube was estimated to be 2×10^{12} per second at a discharge pressure of 1.3 mm Hg for helium and 6×10^{12} per second at a discharge pressure of 0.8 mm Hg for neon. The ratio of metastables to ground-state atoms leaving the discharge was 1×10^{-5} for helium and 8×10^{-5} for neon. L.E.W.

N67-22655*# Massachusetts Inst. of Tech., Cambridge.
GASEOUS ELECTRONICS
S. C. Brown, W. P. Allis, G. Bekefi, J. C. Ingraham, E. M. Mattison et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 137–140 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

The electron–electron relaxation rates as determined from the observed time-dependent electron velocity distribution are discussed. Parameters which measure the departure from the Maxwellian velocity distribution after a few microseconds of the electron–electron interaction are considered. A simple collisional model was developed which gives the time-dependence of the parameters, provided electron–electron interactions dominate. N.E.N.

N67-22674# Naval Radiological Defense Lab., San Francisco, Calif.
EXPOSURE RATES FROM THE PRODUCTS OF FAST NEUTRON FISSION OF U^{235} AND U^{238} AT SELECTED TIMES AFTER FISSION
Leland R. Bunney and Daniel Sam 28 Oct. 1966 24 p refs
(USNRDL-TR-1106; AD-646004) CFSTI: HC $3.00/MF $0.65

The exposure rates per fission per square centimeter at three feet above a uniformly contaminated plane were calculated for nine selected times (1/4 to 72 hours) after fast neutron fission of U235 and U238. The calculations were made from experimentally-determined gamma-ray spectra of the fission products. Author (TAB)

N67-22861*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERPRETATION OF (d,α) REACTIONS ON FLUORINE 19 AND NITROGEN 15
Joseph R. Priest and John S. Vincent Washington, NASA, Apr. 1967 21 p refs
(NASA-TN-D-3813) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The angular distributions of five alpha-particle groups from $F^{19}(d,\alpha)O^{17}$ and $N^{15}(d,\alpha)C^{13}$ were measured. These reactions are alpha-particle emitting reactions from deuterons incident upon fluorine 19 and nitrogen 15 leaving oxygen 17 and carbon 13, respectively, as the residual nuclei. The ground and first two excited states of oxygen 17 and the ground and first excited state of carbon 13 were resolved. The nominal deuteron energy was 20.9 MeV in the laboratory system. The distorted-wave Born approximation calculation for a direct-interaction mechanism provided an adequate interpretation of the reactions. The differential cross sections integrated from 20° to 170° were not proportional to 2l+1 (l is the angular momentum quantum number of the residual state). This was interpreted to be a consequence of a direct-interaction mechanism rather than of a compound-nucleus mechanism. Author

N67-22876*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
OBSERVATIONS OF NUCLEI HEAVIER THAN IRON IN THE PRIMARY COSMIC RADIATION

J. F. Ormes, T. von Rosenvinge, and W. R. Webber Jan. 1967 9 p refs
(Grant NsG-281)
(NASA-CR-83419; CR-92) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Systematic studies of the charge and energy spectra of primary cosmic rays with a large area Cerenkov-Scintillation counter on over 10 balloon flights have yielded new limits on the intensity of nuclei significantly heavier than iron. In the course of identifying over 2000 events as due to iron group nuclei, two events which could possibly be related to nuclei with $Z \geq 36$ have been observed. A lower limit of 1000:1 for the ratio of these groups of nuclei is obtained along with an upper limit to the intensity of $Z \geq 36$ nuclei of $4 \times 10^{-6}/cm^2$-ster-sec. The details of these measurements and some of their astrophysical implications are discussed. Author

N67-22901# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.
ATOMIZING OF SOLID BODIES BY ION BOMBARDMENT [ZERSTAEUBUNG VON FESTKOERPERN DURCH IONENBESCHUSS]
Kyong-Tschong Rie Sep. 1965 58 p refs In GERMAN
(JUL-304-RW) CFSTI: HC $3.00/MF $0.65

The role of correlative impacts during atomization was investigated by bombarding single-crystal silver and cadmium with A^+ ions of 1.0–7.0 keV. The anisotropic emission of surface atoms and the yield with different ion energies was determined for various crystal orientations. The deposition structure of the emitted atoms from silver was measured for the various temperatures. High-energy (approximately 2.0 MeV) H^+ ion bombardment and penetration experiments were conducted with gold foil. The results are found to agree with those of previous experiments conducted at lower energies. Transl. by K.W.

N67-22908 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
NON-DYNAMICAL INTERGAP PARITY TESTS [NIEDYNAMICZNE CALKOWE TESTY PARZYSTOSCI]
M. Kozlowski and J. Werle Sep. 1966 17 p refs
(INR-741/VII/PH) CFSTI: $3.00

Some non-dynamical integral tests for the parity of unstable particles are proposed. In the case of fermions they consist in measuring the up–down asymmetry in parity violating decays of the type $s \rightarrow 1/2 + 0$. Similar tests can be used in the case of parity conserving three-particle decays of the type $s \rightarrow 1/2 + 0 + 0$. The procedure based on the transversality representation is fully relativistic. Author

N67-22911 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
TOTAL REACTION CROSS-SECTION FOR 24.7 MeV ALPHA PARTICLES IN THE REGION OF A = 60 NUCLEI [CALKOWITE PRZEKROJE CZYNNE NA REAKCJE CZASTEK ALFA O ENERGII 24.7 MeV W OBSZARZE JADER Z A = 60]
Jaroslaw Szmider and Roman Wolski Oct. 1967 7 p refs Presented at the Conf. on Nucl. Phys., Gatlinburg, Tenn., 1966
(INP-503/PL) CFSTI: $3.00

Total reaction cross-sections for the interaction of alpha particles of the energy 24.7 MeV with Cr, Fe, Ni, Co, Cu, and Zn nuclei have been measured by means of the transmission method. A good overall agreement with the predictions of the optical model was obtained with exception of Ni nuclei where the experimental value of cross-section is definitely lower than the theoretical one. Author

N67-22915 Central Lab. for Radiological Protection, Warsaw (Poland).
BETA DOSE RATE MEASUREMENT WITH SILICON COUNTER [POMIAR DAWKI PROMIENIOWANIA BETA DETEKTOREM KRZEMOWYM]
J. Roman and B. Sawicka 1966 14p refs Presented at the 2d Health Phys. Symp., Pecs, Hungary, 1966
(CLOR-57/D)

The use of silicon surface barrier detector, as an extrapolation parallel plate ionization chamber, in measuring of beta radiation dose rate was investigated. The detector response was compared to the surface absorbed dose rate in tissue, measured with an extrapolation air ionization chamber. The correlation is sufficiently good and the extrapolation silicon counter is suitable for use under both laboratory and field conditions. The beta radiation dose rate range from a few milirads to a few hundred rads can be covered. Author

N67-22927# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
AN ANALYSIS OF QUASI-FREE ELECTRON SCATTERING ON NUCLEI AND CALCULATION OF THE ENERGY SPECTRA AND ANGULAR CORRELATIONS OF THE $C^{12}(e,e'p)B^{11}$ REACTION USING THE DISTORTED-WAVE IMPULSE APPROXIMATION
C. Ciofi Degli Atti 15 Nov. 1966 43 p refs
(ISS-66/44) CFSTI: HC $3.00/MF $0.65

In the frame of the shell model with intermediate coupling and using harmonic oscillator wave-functions, the experimental energy spectrum is fitted by varying the wave-function parameters. The oscillator parameters for the 1s and 1p states are then determined. Due to the lack of experimental data on angular correlations, the above analysis does not allow one to draw quantitative conclusions, although it gives a qualitative indication that the best-fit oscillator parameters must be different from those obtained by fitting the experimental angular correlations of (p, 2p) reactions, not taking distortion effects into account. Author

N67-22938# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
BARYON–ANTIBARYON PAIR PRODUCTION IN A QUARK MODEL
S. Badier Dec. 1966 9 p refs
(TH-178) CFSTI: HC $3.00/MF $0.65

Baryon–antibaryon pair production is studied in proton–antiproton collisions, in relation to quark models. A conservation law for the spin of interaction particles permits the calculation of efficient sections for the octet and the decuplet pairs of SU(3). Comparison with experimental values, despite great uncertainty in measurements, appears to give satisfactory results for the approximations of the model considered. Transl. by R.Ll.

N67-22939# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculté des Sciences.
PRODUCTION OF η AND THE DEPHASING ANALYSIS OF THE Π-NUCLEON DIFFUSION [LA PRODUCTION DE η ET LES ANALYSES EN DEPHASAGE DE LA DIFFUSION Π-NUCLEON]
G. Mennessier Dec. 1966 19 p In FRENCH
(TH-177) CFSTI: HC $3.00/MF $0.65

A mathematical discussion is presented on nuclear reactions, particle production, scattering amplitude, photoproduction, isobaric model, coupling, and other concepts pertaining to nuclear physics. Transl. by R.Ll.

N67-22945# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.

THE CALCULATION OF RESONANCE CAPTURES IN A FEW-GROUP APPROXIMATION

J. R. Askew Jun. 1966 27 p refs

(AEEW-R-489) HMSO: 4s

The theory of few-group treatment of resonance captures is expounded, and appropriate methods for the spatial and energy averaging of cross sections are derived in a form suitable for machine computation, i.e., as material cross sections which can be used directly in the neutronics code. The method treats both self and mutual shielding of resonances in geometries ranging from homogeneous mixtures, through regular rod arrays to clustered fuel assemblies, and includes the effect of spatial source distribution, for example between moderator and coolant in pressure tube configurations. A particular application of the method has been to the lattice calculation code WIMS, and a sample 10-group library of data for U-238 and U-235 as used in this code is included. Author

N67-22951# Tokyo Univ. (Japan). Inst. of Physics.

LOW-ENERGY BEHAVIORS OF THE T=0, S-WAVE, π–π SCATTERING PHASE SHIFT AND A POSSIBLE SCALAR MESON NONET

Haruichi Yabuki [1966] 14 p refs

CFSTI: HC$3.00/MF$0.65

All the possible low-energy behaviors of the T=0, S-wave π–π phase shift $\delta(k)$ are investigated using the effective range formula. It is found that there exists a case satisfying the conditions (1) that the phase shift $\delta(k)$ rises through $\pi/2$ at about the ρ-meson mass without any appreciable bump in the cross section around this point and (2) that the scattering length is small, say $0.5m_\pi^{-1}$ or smaller. The values of the scattering length a and the effective range r are severely restricted by the above two conditions (1) and (2), that is, $a \approx -r \approx 0.5m_\pi^{-1}$, which is compatible with the recent result of Weinberg both in sign and in magnitude. If we allow a broad enhancement in the lower energy region or if we take a larger value for the position of the phase shift passing through $\pi/2$, then we can get a smaller scattering length. A possible scalar meson nonet associated with this phenomenon is proposed. Author

N67-22952# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

TWO NUCLEONS EMISSION PROCESS IN χ^--MESONS ABSORPTION

Il-Tong Cheon Dec. 1966 30 p refs

(RIFP-59) CFSTI: HC$3.00/MF$0.65

The effects of the short-range N–N correlations on the branching ratio W(pn → nn)/W(pp → pp), the distribution of the absorption rate with respect to the projection of the opening angle between the emitted nucleons, and on the total absorption rate in negative pion absorption by C^{12} nuclei are investigated. Author

N67-22954# Tokyo Univ. (Japan). Dept. of Physics.

ON THE FUNDAMENTAL CONCEPTS IN THE THEORY OF ELEMENTARY PARTICLES. I: HISTORY OF THE TOMONAGA THEORY OF FIELDS

Mituo Taketani (Rikkyo Univ.), Seitnaro Nakamura, and Yoichi Fujimoto (Waseda Univ.) [1966] 13 p refs

CFSTI: HC$3.00/MF$0.65

A historical review of the development of the super-many-time theory and the renormalization theory is presented, and the applications to quantum field theory, especially quantum electrodynamics are discussed. Tomonaga's formulation of the field theory in a completely four-dimensional way is described. The cohesive meson or C-meson field proposed by Sakata for solving the divergent difficulties about self energy and field theory is outlined. It is pointed out that one of the remarkable contributions of the cohesive meson theory was an attempt to deduce the mass difference between proton and neutron. It is shown that the C-meson theory meets the conditions required from the analysis on the quantum electrodynamics conflict published by Bethe and Oppenheimer. N.E.N.

N67-22956# Tokyo Univ. (Japan). Dept. of Physics.

ON THE FUNDAMENTAL CONCEPTS IN THE THEORY OF ELEMENTARY PARTICLES. II: PRESENT PROBLEMS

Mituo Taketani, Seitaro Nakamura, Yoichi Fujimoto (Waseda Univ.), Masayuki Nagasaki, Susumu Furuichi (Rikkyo Univ.) et al [1966] 20 p refs

CFSTI: HC$3.00/MF$0.65

Theories concerning the internal structure of elementary particles with finite dimension are reviewed, emphasizing the Sakarta quark-type model. Details are given of the development of the concepts and the difficulties involved. The baryon family and the baryon–meson system, heavy bosons, and cohesive mesons are considered, along with mass formulas, spin, the violation of time reversal invariance, and charge conjugation invariance. N.E.N.

N67-22973# Japan Atomic Energy Research Inst., Ibaraki.

RADIANT INTENSITY DETERMINATION OF PULSED PHOTON BEAMS BY PULSE-HEIGHT MEASUREMENTS

Masakuni Narita, Hiroaki Tanida, Hisashi Okada, and Yasutomo Ozawa Jan. 1966 12 p refs Submitted for publication Revised

(NSJ-TR-4, Rev.) CFSTI: HC$3.00/MF$0.65

The bremsstrahlung emitted from particle accelerators is highly energetic and intensely pulse-modulated. It is experimentally verified that commercially available G–M counters of alcohol-quenched type produce huge pulse heights which are proportional to the intensity of incident pulse-modulated photons by lower applied voltage than the usual G–M starting voltage. By the use of these characteristics, the instantaneous value of radiant intensity for intense pulse-modulated radiation can be determined by pulse height measurements and their mean value by storing voltage measurements of the counter. This method will be applied to regulate the operation of the output from the nuclear radiation sources. Author

N67-22978# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.

PILE NEUTRON CAPTURE CROSS SECTIONS OF RARE EARTH ISOTOPES

R. Dobrozemsky, E. Formann, G. Lugmair, F. Pichlmayer, F. P. Viehboeck et al [1966] 14 p refs Submitted for publication

(SGAE-PH-47/1966) CFSTI: HC$3.00/MF$0.65

Determination of pile neutron cross sections by the mass spectrometric method, in which samples of known isotopic composition are irradiated and the changes in isotopic composition after irradiation are measured, is discussed. It is pointed out that since the accuracy of the measurement of an isotopic ratio is limited, an isotope should be enriched as highly as possible. Tabular data are given on the mass spectrometric analysis of enriched Yb-174, isotopic compositions of samples before and after irradiation, and cross sections of gadolinium and ytterbium. I.E.W.

N67-22982# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

BINDING ENERGIES OF THE NEXT INNER SUBSHELL OF ATOMS AND IONS FROM B TO ZN

Wolfgang Lotz Oct. 1966 22 p refs

(IPP-1/54) CFSTI: HC$3.00/MF$0.65

Binding energies of the next inner subshell are given for most ionization stages of the elements boron through zinc (Z=30). These

binding energies are calculated along isoelectronic sequences with full regard to experimental values. Similarities in the periodic table are taken into account. Author

N67-22990# Laboratoire de Physique Theoraque et des Hautes Energies, Orsay (France).
HYPERON-NUCLEON INTERACTIONS AND ASSOCIATE PRODUCTION ON THE DEUTERON
F. M. Renard and Y. Renard Dec. 1966 34 p refs
(TH-175) CFSTI: HC $3.00/MF $0.65

The knowledge of hyperon-nucleon interaction from final-state interaction processes are emphasized. The general formalism for reactions of the type (γ or π) + deuteron → K + hyperon + nucleon is written in a complete relativistic manner. It allows the precise calculation of the K-meson spectrum which is particularly sensitive to the hyperon-nucleon interaction in low partial waves. The dynamics includes the relativistic impulse approximation with γ + nucleon → K + hyperon and the n-p-d vertex functions and final state interactions between K-nucleon and hyperon-nucleon (elastic, charge exchange and $\Sigma-\Lambda$ conversion); it is shown that high-order corrections may be taken roughly into account with an overall free normalization factor. General expressions for cross sections and partial-wave decomposition are explicitly given. These results apply for Λ-nucleon and Σ-nucleon processes. They are easily extended to the crossed reactions $\bar{K}$ + deuteron → (γ or π) + hyperon + nucleon. Author

N67-22995# Tokyo Univ. (Japan). Dept. of Physics.
INTERPRETATION OF $\eta \rightarrow 3\pi$ AND $K \rightarrow 2\pi$ BY THE MESO-STRONG INTERACTIONS
Seitaro Nakamura, Shigeo Sato, (Rikkyo Univ.), Masataka Igarashi, Takeo Inami, Nobuyuki Murai et al [1966] 33 p refs
CFSTI: HC $3.00/MF $0.65

By introducing some kinds of meso-strong interactions between baryons and mesons besides the known kinds of the strong interactions, a number of the forbidden modes of decay, such as $\eta \rightarrow 3\pi$(G-parity forbidden), $K^+ \rightarrow 2\pi(\Delta I = 1/2$ rule violating), and $K_2^0 \rightarrow 2\pi$(CP-law violating) are shown to be explained unifiedly. Even if we assume a meso-strong interaction which violates CP-law and can, therefore, be responsible for $K_2^0 \rightarrow 2\pi$, we are not led to considerable violation of charge symmetry of pions (π^+ and π^-) emitted in $\eta \rightarrow 3\pi$. (≈2% violation at the most).
Author

N67-23001# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
DENSITY DISTRIBUTION OF A MOLECULAR FLUX FROM A SHORT CYLINDRICAL TUBE
J. H. de Leeuw and E. O. Gadamer (McMaster Univ.) Feb. 1967 55 p refs
(UTIAS-TN-103) CFSTI: HC $3.00/MF $0.65

The radial density distribution of the molecular flux emerging from a short cylindrical tube, which connects two low-density gas chambers, is calculated both in the exit plane of the tube and just downstream of that plane. The calculations are based on the kinetic theory of gases. It is assumed that the upstream density is low enough so that free-molecule conditions prevail at the tube inlet, and that the distribution function in the upstream chamber is a Maxwellian with zero average velocity. The molecules emerge into a near-vacuum which is maintained in the downstream chamber. Computations have been made for the tube length-to-diameter ratios 0.25, 0.50, 0.75, and 1.00, using the IBM 7040 electronic digital computer facility at McMaster University. The study was undertaken to provide theoretical results complementing an experimental investigation of the density distribution in a low-density air jet emerging from a cylindrical tube of length-to-diameter ratio 1.00. We have found satisfactory agreement between our experimental and calculated results. Author

N67-23003# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A MODEL FOR ELASTIC SCATTERING AT HIGH ENERGY AND LARGE MOMENTUM TRANSFER
A. P. Contogouris Nov. 1966 12 p refs
(TH-174) CFSTI: HC $3.00/MF $0.65

This work presents a model on elastic proton–proton scattering at high energy and large momentum transfer. One important feature is that, for center-of-mass angles $30^\circ \lesssim \theta_{cm} \lesssim 80^\circ$, the data at each energy satisfy a given relation which seems to hold over a region where the differential cross sections vary by ≈8 orders of magnitude. Furthermore, some experimental information for elastic πp scattering at 8 and 12 GeV/c and for elastic $\bar{p}$p scattering at ≈3.5 GeV/c seems to be consistent with the relation for pp scattering. Author

N67-23005# Tokyo Univ. (Japan). Inst. of Physics.
I = J = 0 DIPION STATE WITH A CDD POLE
Yasunori Fujii Jan. 1967 13 p refs
CFSTI: HC $3.00/MF $0.65

In this note we propose a new analysis of the dipion state with I = J = 0 without introducing a "σ meson," but assuming that a pole dominates the inverse scattering amplitude. Main features are: (1) In the 3π decays, the observed decay spectra deviate from the simple phase volume in that the existence of the σ meson with I = J = 0 having the mass ≈400 MeV and the width ≈100 MeV is suggested. (2) In the other processes including the K_{e4} decay, no evidence has been found indicating any sharp peak in the scattering cross section of the 0–0 dipion state at low energies ($\lesssim$ 1 BeV). (3) The phase shift of the 0–0 dipion state at the ρ meson mass is sufficiently large to give a forward–backward asymmetry in the decay $\rho^0 \rightarrow \pi^+\pi^-$. (4) The K_2^0 meson is heavier than the K_1^0. Author

N67-23018# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
ON THE SHIELDING FOR THE QUENCHING SHAFT OF THE FRASCATI LINAC [SULLE SCHERMATURE PER I POZZI DI SPEGNIMENTO DEL LINAC DI FRASCATI]
M. Ladu, M. Pelliccioni, and M. Roccella 19 Sep. 1966 10 p refs In ITALIAN *Its* Nota Interna No. 332
(LNF-66/44) CFSTI: HC $3.00/MF $0.65

Copper plates, immersed in water, are used with a 400 MeV frascati linear accelerator as radiation protection. Mathematical expressions are derived for high resonant neutrons, and the radiation attenuation is calculated. For economic considerations, this simple solution is presented. It was shown that 4 meters of earth is enough protection against radiation since at the same time access to radiation zones was prohibited for a 25-meter area.
Transl. by R.Ll.

N67-23022# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
ULTRAVIOLET CORRECTIONS FOR THE PROCESS $E^+ + E^- \rightarrow M^+ + M^- + \Gamma$ AND THE VALIDITY LIMIT OF THE BLOCH–NORDSIECK METHOD [LE CORREZIONI ULTRAVIOLETTE PER IL PROCESSO $E^+ + E^- \rightarrow M^+ + M^- + \Gamma$ E IL LIMITE DI VALIDITA' DEL METHODO DI BLOCH-NORDSIECK]
G. Rossi 7 Nov. 1966 11 p refs In ITALIAN *Its* Nota Interna No. 334
(LNF-66/51) CFSTI: HC $3.00/MF $0.65

In relation to radiative correction of experimental results from high energy, small particle mass interactions, an ultraviolet correction method was developed and found to be highly accurate. Mathematical expressions of the Bloch-Nordsieck method are given.
Transl. by R.Ll.

N67-23028# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

EXPERIMENTAL RESULTS OF THE STUDY OF NUCLEAR STRUCTURE BY MEANS OF PIONS [PROPOSTA DI ESPERIENZA PER LO STUDIO DELLA STRUTTURA NUCLEARE MEDIANTE PIONI]

C. Guaraldo, C. Mancini, P. Picozza, C. Schaerf, and R. Scrimaglio 21 Nov. 1966 10 p refs In ITALIAN *Its* Nota Interna No. 338

(LNF-66/57) CFSTI: HC$3.00/MF$0.65

The Frascati linear accelerator was used to study low energy pion beams. The incident gamma beam, produced by bremsstrahlung of electrons in heavy elements, was used in the photoproduction of the pions. The following concepts were discussed briefly: scattering lengths, range of nucleons, elastic scattering, inelastic scattering, isospin effect, charged particle path, magnetostriction chamber, and counting velocity. Transl. by R.Li.

N67-23027# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe.

THE DISPERSION CURVE FOR ROTATION VIBRATION OF A TETRAHEDRAL MOLECULE IN A FACE-CENTERED GRID WITH TETRAGONAL MOLECULAR ORIENTATION [DISPERSIONSKURVEN FUER ROTATIONSSCHWINGUNGEN VON TETRAEDRISCHEN MOLEKUELEN IN EINEM FLAECHENZENTRIERTEN GITTER MIT TETRAGONALER MOLEKUELORIENTIERUNG]

R. Stockmeyer Sep. 1966 28 p refs In GERMAN

(JUL-292-RW) CFSTI: HC$3.00/MF$0.65

Thermodynamic calculations were performed in order to obtain the self-oscillation values of molecular crystals having a N numbers of fixed, tetrahedral molecules in the mass M. The inertia moment of the molecule in regard to any axis was Θ, and the x,y,z-coordinates for the deviation of the molecule gravity center from equilibrium were numbered by $q_1 \ldots q_{3N}$, and the rotation angle around the x,y,z-axis was $q_{3N+1} \ldots q_{6N}$. The kinetic energy of the system was then determined by coupling matrix analysis and the symmetrical operations in the tetrahedral phase were established. Transl. by G.G.

N67-23067# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

A QUARK MODEL FOR PARITY VIOLATING NON LEPTONIC DECAYS

S. Badier Jan. 1967 7 p refs

(TH-182) CFSTI: HC$3.00/MF$0.65

A very simple model for pionic two-body hadron decays is presented which relates S-wave hyperon amplitudes and the K $\rightarrow 2\pi$ decay. If the $|\Delta I| = 1/2$ rule holds, all these amplitudes may be computed in terms of one parameter which fits the experimental data within 25%. Author

N67-23069# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

FINAL STATE Λ-NEUTRON INTERACTIONS IN $\gamma + d \rightarrow K^+ + \Lambda + N$

F. M. Renard and Y. Renard Dec. 1966 13 p refs

(TH-176) CFSTI: HC$3.00/MF$0.65

Hyperfragments and direct Λ-proton scattering give inconsistent results for Λ-nucleon interaction parameters. Final-state interactions may help to clarify the situation; in particular, they are the only way to have pure Λ-neutron interaction. The reaction $\gamma + d \rightarrow K^+ + \Lambda + n$ is an example of such a case and is here studied carefully; the K^+-spectrum and its deformation due to the low energy Λ-n interactions are examined. The comparison with experiment allows the determination of the S-wave effective range parameters. Author

N67-23075# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz.

SPHERE TECHNIQUES FOR MEASURING FLUX DENSITIES AND DOSE RATES OF THERMAL, INTERMEDIATE AND FAST NEUTRONS [KUGELTECHNIKEN ZUR MESSUNG VON FLUSSDICHTE UND DOSISLEISTUNGEN THERMISCHER, INTERMEDIAERER UND SCHNELLER NEUTRONEN]

D. Nachtigall and F. Rohloff Nov. 1964 53 p refs In GERMAN; ENGLISH summary

(JUL-213-ST) CFSTI: HC$3.00/MF$0.65

For radiation protection it is important to know the following quantities in a neutron field: flux density, energy dose rate, dose rate equivalent. The neutron scintillation counter with LiJ(Eu) crystal and polyethylene spheres is very useful for these purposes. Using a three sphere combination (2", 3-1/2", and 11" diameter) and summing up the count rates taken with the three spheres, neutron flux densities in the energy range from 0.5 eV up to $7 \cdot 10^6$ eV can be measured. A two sphere technique (2-1/4" and 11-3/4" diameter) with weight factors approximates the neutron energy dose curve in the range from 10^{-2} eV up to $7 \cdot 10^6$ eV. Another three sphere combination (5", 7", and 12" diameter) and weight factors give a measurement of the neutron dose rate equivalent in the range from 0.5 eV up to $7 \cdot 10^6$ eV. A biological dose curve can also be approximated between 10^{-2} eV and $7 \cdot 10^6$ eV by a three sphere combination (2", 4", and 7" diameter) and weight factors. Besides LiJ(Eu)-crystals all detectors operating with the $Li^6(n,\alpha)$-reaction are practicable, especially LiF thermoluminescent detectors. Author

N67-23081 European Atomic Energy Community, Brussels (Belgium). Directorate-General for Research and Training Radioisotopes Group.

PRELIMINARY STUDY TO THE DEVELOPMENT OF A NEUTRON SOURCE WITH A FISSION-PRODUCT BASIS (EURATOM NEUTRON SOURCE) [ETUDE PRELIMINAIRE A LA MISE AU POINT D'UNE SOURCE DE NEUTRONS A BASE DE PRODUITS DE FISSION (EURATOM NEUTRON SOURCE)]

S. Godar and G. Verfaillies Jan. 1967 14 p refs In FRENCH; ENGLISH summary

(EUR-3252.f) CFSTI: $3.00

This report deals with the preliminary tests relating to the use of fission products, such as Ce^{144}-Pr^{144} and Ru^{106}-Rh^{106}, for the fabrication of neutron sources. Judging from the results obtained, these sources have certain advantages (higher neutron flux, longer half-life and low cost) over those with a basis of Sb^{124}. Author

N67-23082# Royal Aircraft Establishment, Farnborough (England).

FIFTY YEARS OF QUANTUM THEORY [50 JAHRE QUANTENTHEORIE]

W. Heisenberg Dec. 1966 16 p Transl. into ENGLISH from Naturwiss. (West Berlin), v. 38, 1951 p 49-55

(RAE-LIB-TRANS-1202) CFSTI: HC$3.00/MF$0.65

Quantum theory up to 1950 is reviewed. All the important theories and discoveries are described in a qualitative, sometimes metaphysical, manner. Some insight into the conceptual difficulties encountered by physicists fifty years ago is provided by a description of the author's own work in the field of quantum theory. Every development of the theory is mentioned, though sometimes only briefly. The article provides a starting point for detailed reading of any aspect of quantum theory. Author

N67-23084# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

SOME RESULTS OF THE MONTECARLO CALCULATION OF THE (e, e' p) REACTION FOR INCIDENT ENERGIES BETWEEN 300 AND 600 MeV

G. Farchi 10 Oct. 1966 45 p refs

(ISS-66/37) CFSTI: HC$3.00/MF$0.65

The purpose of the present report is to present some Monte Carlo calculations of the (e,e'p) reaction in a form useful for planning coincidence experiments with high duty cycle electron accelerators in the energy range between 300 and 600 MeV. Author

N67-23091# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente.
CONTEMPORARY PROCESSES OF SPECTROSCOPY OF FAST NEUTRONS USING THRESHOLD VALUE PROBES [GEGENWAERTIGE VERFAHREN ZUR SPEKTROSKOPIE SCHNELLER NEUTRONEN MIT HILFE VON SCHWELLWERT-SONDEN]
L. Weise Oct. 1966 52 p refs In GERMAN
(JUL-414-RX) CFSTI: HC $3.00/MF $0.65

Several methods for determining the spectrum of fast neutrons by means of activation probes are compared for accuracy and their dependence on basic experimental data, the activations A_i, and the excitation functions $\sigma_i(E)$ of a series of N-varying threshold value probes ($i = 1...N$). The methods are specifically evaluated for application in reactor spectroscopy. Transl. by K.W.

N67-23163# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Labs.
LOWER BOUNDS FOR SOME POTENTIAL ENERGY CURVES OF H_2 AND He_2
Philip Jennings [1967] 5 p refs
(Contract Nonr-1866(14); Grant NSF GP-6413)
(AD-645800) CFSTI: HC $3.00/MF $0.65

Use was made of a 2 x 2 determinant in order to apply the method of Miller (J. Chem. Phys. v42 p4305 1965) to the calculation of the lower bounds to energy eigenvalues of the excited singlet-Sigma-G(+) states of H2 and to the two lowest singlet-Sigma-G(+) states of He2(++). TAB

N67-23165# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
IMPROVED LOWER BOUNDS TO THE OVERLAP INTEGRAL OF AN APPROXIMATE WAVEFUNCTION WITH THE TRUE WAVEFUNCTION
Frank Weinhold [1967] 4 p refs
(Contract Nonr-1866(14); Grant NSF GP-6413)
(AD-645799) CFSTI: HC $3.00/MF $0.65

Lower bounds to the overlap integral for approximate beryllium wave functions are given. TAB

N67-23173# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.
KINEMATICS OF MULTIPARTICLE PROCESSES
Donald A. Jacobson Apr. 1966 42 p refs *Its* Douglas Paper 4019
(AD-644980) CFSTI: HC $3.00/MF $0.65

A thorough analysis is made of the kinematics of a general scattering process involving N particles. The following structural properties are proved for the physical region: (1) The physical regions for individual channels are connected and mutually disjoint. (2) The entire physical region can be decomposed into a sum of three real analytic manifolds of dimension 3N-10, 2N-6, and N-3, plus a finite set of points. (3) The physical region can be imbedded in a connected 3N-10 dimensional analytic set, which in turn can be decomposed into a sum of three complex analytic manifolds of dimension 3N-10, 2N-6 and N-3, plus a finite set of points. Author (TAB)

N67-23191# Joint Inst. for Nuclear Research, Dubna (USSR).
CALCULATION OF A DOUBLE CHARGE EXCHANGE OF π-MESONS BY NUCLEI [RASCHET PROTSESSA DVOINOI PEREZARYADKI π-MEZONOV NA YADRAKH]
Yu. A. Batusov, V. I. Kochkin, and V. M. Mal'tsev 3 Nov. 1966 13 p refs In RUSSIAN Submitted for publication
(JINR-P2-3004)

Using the cascade model for π-meson interaction by nucleus by the Monte-Carlo method the total cross sections are calculated for a double charge exchange of π-mesons by nuclei in the photo-emulsion at different energies of primary mesons in the range of 50–300 MeV. The dependence of the cross section on the atomic number of the nucleus is obtained and the energy and angular distributions of secondary mesons are calculated. Author (NSA)

N67-23192# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DYNAMIC GROUP OF THE SCALAR SU(3) SYMMETRIC STRONG COUPLING THEORY
M. Bednar and J. Tolar 1966 21 p
(JINR-E2-3044)

Using a simple minimalization requirement for the $SU(3)\text{-}T_8$ invariant part of the Hamiltonian of the scalar SU(3) symmetric strong coupling theory the physical unitary irreducible representation of the dynamical group $SU(3)\text{-}T_8$ was found and its composition in terms of SU(3)-representations was determined. This approach permits a simple explanation of the presence of the SU(3) singlet in the case of pure D-coupling. Author (NSA)

N67-23193# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INVESTIGATION OF THE GREEN FUNCTION EQUATION IN A NONRENORMALIZED THEORY [ISSLEDOVANIE URAVNENIYA DLYA FUNKTSII GRINA V NERENORMIRUEMOI TEORII]
L. G. Litvinenko 25 Nov. 1966 10 p refs In RUSSIAN Submitted for publication
(JINR-P2-3038)

Renormalized Dyson equation is investigated by the peratization method in the ladder approximation for the case of scalar particles and massive vector particles interaction. Author

N67-23194# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
QUANTUM THEORY OF SCALAR FIELD WITH NONSTATIC SOURCE [KVANTOVAYA TEORIYA SKALYARNOGO POLYA S NESTATICHESKIM ISTOCHNIKOM]
M. I. Shirokov 25 Nov. 1966 18 p refs In RUSSIAN Submitted for publication
(JINR-P2-3040)

It is shown that the physical vacuum and real meson are not described by in-out states in the case of scalar field interacting with nonstatic source. After the physical vacuum vector and the real meson annihilation-production operator are defined the Fock amplitudes, defined by means of them, are introduced. The reformulation of the theory in terms of these amplitudes leads to an equation which essentially differs from the initial Schrodinger equation. Author (NSA)

N67-23195# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
INVESTIGATION OF ^{182}Ta γ-IRRADIATION BY USING A SEMICONDUCTOR SPECTROMETER [ISSLEDOVANIE GAMMA-IZLUCHENIYA ^{182}Ta NA POLUPROVODNIKOVOM SPEKTROMETRIE]
N. Voinova, Ya. Vrzal, B. Dzhelepov, Ya. Liptak, and Ya. Urbanets 14 Oct. 1966 36 p refs In RUSSIAN
(JINR-P6-2979)

The gamma spectrum of ^{182}Ta for the energy range 50 to 1500 keV was investigated using a semiconductor spectrometer with a Ge(Li) detector. All previously known ^{182}Ta γ transitions were observed; their relative intensities were determined. The

results obtained are in satisfactory agreement with those from previous observations. The values of conversion coefficients and multi-polarities of the observed transitions were determined. The intensity balance of the γ transitions between ^{182}W levels was obtained. The intensities of β^- components and the values of log ft were found. Author (NSA)

N67-23196# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

SYNTHESIS OF Fm ISOTOPES WITH MASS NUMBERS 247 AND 246 [SINTEZ ISOTOPOV FERMIYA S MASSOVYMI CHISLAMI 247 I 246]

V. I. Ilyushchenko, M. B. Miller, V. L. Mikheev, S. M. Polikanov, and V. A. Shchegolev 14 Nov. 1966 10 p refs In RUSSIAN Submitted for publication

(JINR-P7-3022)

In the nuclear reactions $^{239}Pu(C\text{-}12,4n)^{247}Fm$ and $^{239}Pu(C\text{-}12,5n)$ ^{246}Fm, the ^{247}Fm and ^{246}Fm isotopes were synthesized. Their radioactive properties were studied. For ^{246}Fm $E_\alpha = 8.25 \pm 0.03$ MeV and $T_{1/2} = 1.6 \pm 0.4$ sec ^{247}Fm has two alpha lines, one with $E_\alpha = 7.87 \pm 0.05$ MeV ($\approx 70\%$) and $E_\alpha = 7.93 \pm 0.05$ MeV ($\approx 30\%$) and a half life of 35 ± 4 sec and another with $E_\alpha = 8.18 \pm 0.03$ MeV and $T_{1/2} = 9.2 \pm 2.3$ sec. One of these states is, apparently, isomeric. Some assumptions are made on the possibility of isomeric state formation, which is connected with the $J_{13/2}$ level for isotopes with N = 147. Author (NSA)

N67-23197# Atomics International, Canoga Park, Calif.

EFFECTIVE INTEGRALS AND ATTENUATION FACTORS FOR GOLD

L. S. Beller and H. Farrar, IV 20 Sep. 1966 97 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-MEMO-12164) CFSTI: HC $3.00/MF $0.65

Measurements of the effective resonance integral, thermal and epithermal self-shielding factors, and cadmium ratios for ^{197}Au in 1/E neutron flux spectra are presented. The range of measurement covers over four decades in surface/mass ratio to provide a quantitative check on the validity of analytical calculations of these quantities. Apparatus, methods, procedures, and corrections are discussed. The results are in excellent agreement both with corrected analytical calculations by the TRIX-I code and with Monte Carlo calculations by the TRAFE code. Corrected TRIX-I calculations agree with the measurements to within a mean of 2.87% for eleven measured points covering four decades. Author (NSA)

N67-23199# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.

NUCLEON–NUCLEON SCATTERING (EXPERIMENTAL ASPECTS)–A BIBLIOGRAPHY, 1961–1966

J. L. Hall Aug. 1966 48 p refs

(AERE-BIB-149) HMSO: 7s

The bibliography includes published articles and unclassified reports on the experimental aspects of nucleon–nucleon (p-p and n-p) scattering at all energies, for the period covered by abstracting journals published between August, 1961 and June 1966. Anti-particles are not included. NSA

N67-23200# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.

EXPERIMENTAL PHONON PHYSICS Progress Report, 1 Apr. 1966–31 Mar. 1967

R. O. Pohl, J. A. Krumhansl, A. J. Sievers, and A. Taylor Dec. 1966 14 p refs

(Contract AT(30-1)-2391)

(NYO-2391-41) CFSTI: HC $3.00/MF $0.65

Measurements were continued of thermal and infrared properties of solids in studies of impurity modes (effects of lattice defects on vibrational spectrum of solids). The results reported include: phonon scattering by tunneling states in KCl:Li, hindered rotation of CN^- in RbCl, test of model for superconducting metals, absence of electric field-induced dichroism of near ir stretching vibration of CN^--doped crystals, search for second sound in pure alkali halide crystals, and development of a doped germanium far ir detector. Other studies are also reported on briefly. A short account is given of the development of the 3.0-MeV Dynamitron. NSA

N67-23201# Iowa State Univ. of Science and Technology, Ames.

SIX AND SEVEN PION ANNIHILATION MODES OF 2.7 GeV/C ANTIPROTONS ON PROTONS

Daryl Eugene Bohning (Ph.D. Thesis) Nov. 1966 46 p refs

(Contract W-7405-ENG-82)

(IS-T-115) CFSTI: HC $3.00/MF $0.65

The results of an investigation of the annihilation of 2.7 BeV/c antiprotons on protons into six and seven pions are presented. The experiment forming the basis of this investigation was carried out using the 33-BeV Alternating Gradient Synchrotron and the 20" Shutt liquid hydrogen bubble chamber. A total six-prong cross section of 5.08 ± 0.39 mb is found to be distributed as: $\sigma(\bar{P}+P \rightarrow 3\pi^+ + 3\pi^-) = 1.05 \pm 0.15$ mb, $\sigma(\bar{P}+P \rightarrow 3\pi^+ + 3\pi^- + \pi^0) = 2.18 \pm 0.40$ mb, and $\sigma(\bar{P}+P \rightarrow 3\pi^+ + 3\pi^- + n\pi^0, n \geq 2) = 1.69 \pm 0.55$, the balance going to kaon final states. Rho and ω production in the six and seven pion final states, respectively, are set at 1.0 ± 0.22 mb and 0.5 ± 0.27 mb, with no evidence for f^0 or $\rho^\pm$ production. In addition, the six pion final state shows some indication of a newly discovered I = 0 meson state at 1670 MeV. From the data this state is estimated to decay to $\rho + \pi^+ + \pi^-$ and $2\pi^+ + 2\pi^-$ in the ratio four to one. Angular distributions and angular correlations are presented along with discussion of their basic features. Author (NSA)

N67-23202# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

DISPERSION SUM RULES IN THE COMPTON SCATTERING BY BARYONS [DISPERSIONNYE PRAVILA SUMM V KOMPTONOVSKOM RASSEYANII NA BARIONAKH]

I. G. Aznauryan 1966 10 p refs

(JINR-P2-3028) CFSTI: HC $3.00/MF $0.65

Sum rules for the photon–baryon scattering are obtained from the ordinary one-dimensional dispersion relations. From these sum rules the relations follow between the baryon magnetic moments and the radiative decay magnetic moments of the nearest resonances which are in good agreement with experiment and the SU(6) symmetry predictions. Author (NSA)

N67-23203# Stanford Univ., Calif. Linear Accelerator Center.

LIFETIME AND DIMENSIONS OF AN ELECTRON BEAM

G. N. Kulipanov, S. G. Popov, A. N. Skrinskii, and G. M. Tumaikin [1966] 18 p refs Transl. into ENGLISH from Vremya Zhizni i Razmery Elektronnogo Puchka v Nakopitele (Novosibirsk), 1966 13 p

(SLAC-TRANS-54) CFSTI: HC $3.00/MF $0.65

Experimental results and calculated relationships characterizing the behavior of the main parameters of an electron beam in a storage ring at low and high intensities are reported. Author (NSA)

N67-23205# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

ANNUAL PROGRESS REPORT, 1966

Oct. 1966 254 p refs

(NP-16419) CFSTI: HC $3.00/MF $0.65

The theoretical work on the free-molecular transport properties associated with the internal flow through axisymmetric tubes is continuing by using wall reflection laws that are more general than that of purely diffuse reflection, which was used in all previous

calculations at UTIAS. The experimental work in the low density wind tunnel has emphasized the study of the basic gas-dynamic flow problems of free jets and shock structure by means of the electron-beam probe. Two important studies have been completed. The behavior of the rotational degree of freedom in nitrogen free jets and shock waves was found to show appreciable nonequilibrium effects and the observed experimental results on the diffusive separation in helium–argon jet expansions agreed very well with available theory. The diffusive separation in shock waves and near aerodynamic obstacles is now under study. Initial experimental work on the separation in shock compression were obtained and the present effort is directed to experiments in which the shock configuration is amenable to analysis. A theoretical study of shock structure in binary mixtures is under way, which is part of a larger overall program on shock structure in multicomponent gases and plasmas. Author (NSA)

N67-23212# Queens Coll., Flushing, N. Y. Dept. of Physics.
THEORETICAL RESEARCH ON RADIATION INDUCED DEFECTS IN LiH
Robert D. Hatcher Dec. 1966 54 p
(Contract AT(30-1)-3657)
(NYO-3657-1) CFSTI: HC $3.00/MF $0.65

Two quantum-mechanical methods are given for calculating interaction energies between the separate ions. The method of off-center ions was also used to study the interaction of Li^+ with other ions. Methods are described for calculating the properties of neutral and charged defects. The theory of nuclear quadrupole resonance is described with its application to Li^+ ions in an ionic crystal. A calculation of interstitial He in LiH was made to test the method. The problem of the large polarizability of H^- is considered. NSA

N67-23214# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
METHODS TAKING ACCOUNT OF COULOMB SCATTERING AND BREMSSTRAHLUNG FOR BUBBLE CHAMBER TRACKS TREATMENT [METODY UCHETA KULONOVSKOGO RASSEYANIYA I TORMOZNOGO IZLUCHENIYAPRI OBRABOTKE KAMERNYKH TREKOV]
Yu. A. Budagov, V. B. Vinogradov, A. G. Volod'ko et al 1966 37 p refs In RUSSIAN
(JINR-P10-3021) CFSTI: HC $3.00/MF $0.65

Methods for determining the kinematic parameters for bubble chamber tracks are considered taking into account fluctuations due to Coulomb scattering and bremsstrahlung. A related computer-program is analyzed in which, by a least squares method using both measurement and scattering matrices, curve with varying curvature is fitted. From this bremsstrahlung is deducpd. The validity of the methods suggested is checked with pictures from the JINR 1m propane bubble chamber in a beam of 5 GeV/c negative pions of the JINR synchrophasotron. Author (NSA)

N67-23224# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
COLLISIONS WITH PARTICLE REDISTRIBUTION [STOLKNOVENIYA S PERERASPREDELENIEM CHASTITS]
I. Amirkhanov, V. P. Zhigunov, and B. N. Zakhar'ev 1966 18 p refs In RUSSIAN
(JINR-P4-2963)

A system of coupled differential equations, describing the scattering processes with particle redistribution is deduced and investigated. A method of solving such a system is suggested. A set of integral equations is obtained for the scattering amplitudes with particle redistribution. Author (NSA)

N67-23226# Argonne National Lab., Ill.
POLARIZATION EFFECTS IN THE COULOMB SCATTERING OF 4 MeV NEUTRONS BY COPPER, LEAD AND URANIUM NUCLEI [EFFEKTY POLYARIZATSII PRI KULONOVSKOM RASSEYANII NEITRONOV S ENERGIEI 4 MeV YADRAMI MEDI, SVINTSA I URANA]
G. V. Gorlov, N. S. Lebedeva, and V. M. Morozov 1966 8 p refs Transl. into ENGLISH from Russian
(ANL-TRANS-371) CFSTI: HC $3.00/MF $0.65

A brief discussion is given of results obtained from the experimental scattering of polarized 4-MeV neutrons over the angles 2, 4, and 6 by Cu, Pb, and U nuclei. It is shown that within the limits of experimental error the concepts developed by Schwinger with respect to the Coulomb scattering of neutrons agree with the measured results, so that it can be assumed that with the scattering of neutrons of such an energy the polarization effects in the small angle region are determined essentially by the Coulomb scattering. The Coulomb polarization capacity of Cu, Pb, and U was calculated on the basis of experimental data for the elastic scattering of neutrons in the angular range $30' \leq \theta \leq 6°$. The polarization in the scattered neutron beam from the D(d,n) reaction was determined as equal to (15.8 ± 1.6)%. Estimates of the magnitude of the square of the real part of the amplitude of the potential nuclear forward scattering were made. Author (NSA)

N67-23233# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
AN EMPIRICAL FORMULA FOR THE ELECTRON IMPACT IONIZATION CROSS SECTION [EINE EMPIRISCHE FORMEL FUER DEN IONISIERUNGSQUERSCHNITT GEGENUEBER ELEKTRONENSTOSS]
Wolfgang Lotz Aug. 1966 27 p refs In GERMAN
(IPP-1/50)

An empirical formula with three free parameters is given for the representation of cross sections for single ionization of atoms and ions from the ground state by electron impact. Almost all experimental results can be approximated by this formula within 10% over the hole energy range between threshold and 10 keV; all experimental results can be approximated within experimental error. The formula proposed is not suitable to reproduce the exact contour of fine structures in the ionization cross section curve. Author (NSA)

N67-23240# Royal Aircraft Establishment, Farnborough (England).
EXPERIMENTS ON THE ACCOMMODATION OF NORMAL MOMENTUM
W. N. Mair, B. W. Viney, and J. S. Colligon Aug. 1966 19 p refs Presented at the 5th Intern. Symp. on Rarefied Gas Dyn., Oxford, 4–8 Jul. 1966
(RAE-TR-66246) CFSTI: HC $3.00/MF $0.65

Measurements are described of the transfer of momentum from a beam of normally incident N_2^+ ions to a copper target forming one arm of a sensitive torsion balance. As the incident ion energy is increased, the accommodation coefficient for the normal component of momentum falls rapidly from unity for 4 eV ions to a minimum value of 0.4 for about 7 eV ions, then increases gradually to an asymptotic value of 0.7 for 50–100 eV ions. Author (ESRO)

N67-23283*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF GRYZINSKI AND BORN CROSS SECTIONS FOR THE METASTABLE 2s STATE OF ATOMIC HYDROGEN
Carl F. Monnin and George M. Prok Washington, NASA, Apr. 1967 34 p refs
(NASA-TN-D-3838) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Excitation and ionization cross sections for electron scattering in metastable atomic hydrogen were calculated by the Born

approximation and by the semiclassical theory of Gryzinski. The transitions investigated were excitations from the 2s level to n=3, 4 and ionization. The energy range of the incident electron was from the threshold to 400 electron volts. In the Gryzinski theory the atomic electrons may be assumed to have a distribution of velocities or a single, average velocity. Excitation cross sections calculated with the use of both assumptions are compared with the results of the Born approximation. The cross section resulting from the velocity distribution agreed better with the Born approximation than with the cross section resulting from the average value of the velocity. Since no experimental results are available, the Born approximation above 200 electron volts is assumed correct. The shapes of the Gryzinski cross section curves are similar to those for the Born approximation over the energy range investigated. Author

N67-23345# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.

PREDICTION OF THE TEMPERATURE-DEPENDENT STATIC FORM FACTOR IN He I AND He II

Richard D. Etters Sep. 1966 32 p refs

(Douglas Paper-4100; AD-644985) CFSTI: HC $3.00/MF $0.65

A method is presented for predicting the temperature-dependent properties of the static form factor in He I and He II at low momenta. The prediction is based upon the observation that a single coherent, collective mode of excitation predominates for temperatures theta < or = 2.57K and momenta k approx = 1/0.6A. An expression is developed for the dissipative part of the density-density response function CHI(k, omega) in the collisionless regime. This result exhibits a slight temperature-dependent energy shift in the position of the main resonance from its value at theta = 0K. However, the sharp resonance structure is retained, reflecting the fact that the collective mode, which is the principal contributor to CHI(k omega) in the regime considered, exists as a nearly independent mode of excitation for all temperatures theta < or = 2.57K. The expressions for the dynamic and static form factors are derived. They appear to be insensitive to superfluid behavior. The temperature dependence of the static form factor Sk(theta) for 0 < or = theta < or = 2.57K is summarized by the inequalities delta-Sk/delta-theta > 0 for k < 1/0.38A and delta-Sk/delta-theta < 0 for k > 1/0.38A. Author (TAB)

N67-23356# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NUCLEAR PHYSICS

I-Hsi Cheng 14 Oct. 1966 18 p ref Transl. into ENGLISH from Yuan-tzu Wu-Li-Hsueh (Communist China), 1965 p 205–214

(FTD-HT-66-421; AD-645824) CFSTI: HC $3.00/MF $0.65

The report attempts to point up developments in nuclear physics in this century and includes discussions on such topics as the atomic bomb; fusion of hydrogen atoms and thermonuclear reactions (the hydrogen bomb); and an atomic nuclear reaction pile. TAB

N67-23370# Naval Radiological Defense Lab., San Francisco, Calif.

BETA SPECTRA V. SPECTRA OF INDIVIDUAL POSITRON EMITTERS

Ora L. Hogan 8 Feb. 1967 134 p refs

(USNRDL-TR-1101; AD-646228) CFSTI: HC $3.00/MF $0.65

Spectra for 219 positron emitters were computed, with energy intervals of .01 MeV (Nb92 and Ta177 at shorter intervals). The computation was based on the Fermi theory of beta decay, with a correction factor for unique-forbidden transitions. These energy spectra, after normalization and plotting, are presented, along with the data used in their computation. Author (TAB)

N67-23381# International Centre for Theoretical Physics, Trieste (Italy).

SUPERCONVERGENCE IN PION PHOTOPRODUCTION

L. K. Pande 9 Feb. 1967 9 p refs Submitted for publication

(IC/67/6) CFSTI: HC $3.00/MF $0.65

Superconvergence in the pion photoproduction process is studied. Only I = 1/2 states occur in the relation; solving it by putting in the nucleon, the result is $\mu_p = -\mu_n$ where μ_p and μ_n are the anomalous magnetic moments of the proton and the neutron, respectively. This result is correct experimentally to within ≈5%. ESRO

N67-23382# International Centre for Theoretical Physics, Trieste (Italy).

MATRIX ELEMENTS FOR IRREDUCIBLE REPRESENTATIONS OF THE U(6,6) ALGEBRA IN HARMONIC FUNCTION SPACE

Anele Maduemezia Nov. 1966 30 p refs Submitted for publication

(IC/66/104) CFSTI: HC $3.00/MF $0.65

The algebra of the group U(6,6) is realized as an algebra of differential operators acting in the Hilbert space of functions defined on a 23-dimensional pseudosphere. The matrix elements of the generators was calculated for certain harmonic function states of this spectra. Author (ESRO)

N67-23385# International Centre for Theoretical Physics, Trieste (Italy).

RELATION BETWEEN BARE AND PHYSICAL MASS OF VECTOR BOSONS IN A TWO-DIMENSIONAL FIELD THEORY

P. L. F. Haberler Dec. 1966 9 p refs Submitted for publication

(IC/66/114) CFSTI: HC $3.00/MF $0.65

Johnson's proof of the relationship between bare and physical mass of vector bosons holds in a two-dimensional theory of massive vector bosons interacting with massive fermions, if one restricts oneself to stable particles. Author (ESRO)

N67-23386# International Centre for Theoretical Physics, Trieste (Italy).

STRESS TENSOR AND THE 2^+ MESONS

R. Delbourgo (Imperial Coll.), Abdus Salam, and T. Strathdee Dec. 1966 31 p refs Revised

(IC/66/115) CFSTI: HC $3.00/MF $0.65

Stress tensors and octet generalizations are suggested as the sources for 2^+ particles. Consequences of such a hypothesis are examined in terms of plausible models for the particle, which is described by a symmetrical and conserved traceless tensor. Matrix elements are discussed for spinor states, and a conventional Feyman diagram is considered in order to fix invarient factors that occur in Regge formulas that are used. Low energy theorems are derived for F^* production, all the members of a nonet of 2^+ particles are treated on the same basis by using quark calculations. M.W.R.

N67-23387# International Centre for Theoretical Physics, Trieste (Italy).

ON DISCRETE DEGENERATE REPRESENTATIONS OF THE CONFORMAL GROUP IN SPACE–TIME

Awele Maduemezia Dec. 1966 27 p refs Submitted for publication

(IC/66/113) CFSTI: HC $3.00/MF $0.65

The homomorphism between the conformal group in space–time and the non-compact group SU(2,2) is used to derive three types of unitary irreducible representations of the conformal group. These representations are realized in Hilbert spaces of harmonic functions. Two of them are equivalent (vector)

representations, while the third is a projective (spinor) representation. All three are degenerate and discrete. The generators of the physical operations of the conformal group are realized as differential operators; some of them explicitly in terms of the variables of the representation space. Matrixes of the translation and dilation operators are calculated between certain harmonic function states. The dilatation operator is found to connect only states whose values of a certain parameter differ by two or zero. It is suggested that, should degenerate discrete-series representations of the type described be relevant to the correct classification of fundamental particles, a simple explanation of the experimentally observed discrete mass spectra might be found in this property of the dilatation operator. Author (ESRO)

N67-23388# International Centre for Theoretical Physics, Trieste (Italy).
NUCLEAR MATRIX ELEMENTS OF FIRST FORBIDDEN BETA TRANSITIONS IN THE NILSSON MODEL
D. Bogdan and P. Lipnik Nov. 1966 40 p refs Submitted for publication
(IC/66/111) CFSTI: HC $3.00/MF $0.65

The influence of the Nilsson parameters on the beta decay of Re^{186}, Re^{188}, and Tm^{170} nuclei was studied. For the Re nuclei, good agreement between Nilsson model predictions and experimental results was obtained by a reasonable variation of these parameters. In the case of Tm^{170}, the high ft values cannot be explained with such a variation of the model parameters. Some of these results are obtained putting the nuclear parameters in a suitable form, using a new parametrization for the nuclear matrix elements in the framework of the Nilsson model. Author (ESRO)

N67-23389# International Centre for Theoretical Physics, Trieste (Italy).
PERTURBATION OF RESONANCE STATES AND ENERGY SHIFT IN MIRROR NUCLEI
J. Humblet and G. Lebon Nov. 1966 22 p refs Submitted for publication
(IC/66/106) CFSTI: HC $3.00/MF $0.65

Defining the resonance states of a nucleus according to the S-matrix theory of nuclear reactions, the perturbation of their positions and widths are calculated to the first order for a given perturbation of the Hamiltonian. The results are applied to the computation of the energy shift of some levels of light mirror nuclei. Author (ESRO)

N67-23390# Aktiebolaget Atomenergi, Stockholm (Sweden).
POSSIBLE DEFORMED STATES IN ^{115}In AND ^{117}In
A. Backlin, B. Fogelberg (Uppsala Univ.) and S. G. Malmskog Jan. 1967 40 p refs
(AE-263) CFSTI: HC $3.00/MF $0.65

Presents half life measurements on two levels in In^{115} and three levels in In^{117} using the method of delayed coincidences. The gamma ray spectra from Cd^{115} and Cd^{117} have been recorded with a Ge(Li) detector. To obtain accurate transition energies and establish the parities and possibly the spins of the low energy levels, internal conversion lines of some of the transitions in both In isotopes have been recorded by a double focusing beta spectrometer. ESRO

N67-23393# International Centre for Theoretical Physics, Trieste (Italy).
THE Λ-Λ-HYPERNUCLEUS $_{\Lambda\text{-}\Lambda}He^{6}$
Shamher Ali and A. R. Bodmer Dec. 1966 39 p refs Sponsored in part by Manchester Univ.
(IC/66/112) CFSTI: HC $3.00/MF $0.65

The double (lambda-lambda) hypernucleus of helium 6 is studied with a three-body model based on results obtained for beryllium 10. Binding energy of the helium hypernucleus is calculated, as are the shape dependence of various hard core and other potentials on scattering length and the effective range. Different potentials with different shapes but the same intrinsic range are found to be nearly equivalent for these hypernuclei. Meson theoretical and other hard core potentials are treated in detail, and their implications are noted. M.W.R.

N67-23396# Aktiebolaget Atomenergi, Stockholm (Sweden).
DECAY PROPERTIES OF ^{147}Nd
Anders Backlin (Uppsala Univ.) and Sven G. Malmskog Feb. 1967 17 p refs
(AE-265) CFSTI: HC $3.00/MF $0.65

Electron and gamma transition energies and intensities in the decay of Nd^{147} have been studied using a double focusing beta spectrometer and a Ge(Li) detector. From the deduced multipolarities of the transitions, all levels in Pm^{147} are found to have positive parity in contrast to the fact that the neighboring nucleus Pm^{149} has been found to have several low lying negative parity states. Author (ESRO)

N67-23397# Aktiebolaget Atomenergi, Studsvik (Sweden).
DECAY OF THE 16.3 MIN ^{182}Ta ISOMER
Mats Hoejeberg (Stockholm Univ.) and Sven G. Malmskog Jan. 1967 14 p refs
(AE-264) CFSTI: HC $3.00/MF $0.65

Some transitions in the decay of the 16.3 min Ta^{182} isomer have been studied with a Ge(Li) detector and a double lens electron coincidence spectrometer. Gamma ray and conversion electron intensities were measured. From a delayed coincidence experiment, it was concluded that both of the two lowest excited estates in Ta^{182} had a half life less than 30 psec. Author (ESRO)

N67-23399# Centre National de la Recherche Scientifique, Verrieres-le-Buisson (France).
PHYSICAL STRUCTURE OF RESONANCE RADIATIONS EMITTED BY AN ALKALI ARTIFICIAL CLOUD AND MEASUREMENT OF IONOSPHERE TEMPERATURE [STRUCTURE PHYSIQUE DES RAIES DE RESONANCE EMISES PAR UN NUAGE ARTIFICIEL D'ALCALINS ET MESURE DE LA TEMPERATURE DE L'IONOSPHERE]
Marie-Lise Lory-Chanin (Ph.D. Thesis—Paris Univ.) 15 Jun. 1965 51 p refs In FRENCH; ENGLISH summary *Its* Ser. A, No. 4617
CFSTI: HC $3.00/MF $0.65

The resonance radiation emitted by an alkali cloud was studied to understand which conditions the line shape has a Doppler width characteristic of the temperature of the medium. By artificially creating such clouds in the upper atmosphere, measurements of the temperature at high altitude have been made. The effects of different perturbations on the emitted radiation, mainly the multiple scattering, and the problem of radiative transfer inside the cloud was studied. The absorption technique is described and the resultant temperatures for experiments on Na and K clouds between 100 and 400 km during the 1959–1964 period are presented. The systematic nature of the measurements permitted correlation with altitude and solar cycle. Author (ESRO)

N67-23450# National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON ATOMIC TRANSITION PROBABILITIES
B. M. Glennon and W. L. Wiese 22 Apr. 1966 104 p refs Supersedes NBS-Monograph-50
(NBS Misc. Publ.-278; NBS-Monograph-50) CFSTI: HC $3.00/MF $0.65

A revised and updated bibliography on atomic transition probabilities is presented. The papers are arranged according to elements and stages of ionization, and the method employed and class of transitions are indicated behind each reference. Only

articles on discrete transitions, both permitted and forbidden, are listed. Also included is a supplementary list of important papers dealing with transition probabilities from a general point of view, and a table of comprehensive papers not included in the element list. Author

N67-23455# Joint Publications Research Service, Washington, D. C.
PRACTICABILITY OF PRODUCTION AND APPLICATION OF NEUTRON SOURCES IN YUGOSLAVIA
Djordje Nemoda 16 Jan. 1967 10 p refs Transl. into ENGLISH from Tehnika (Belgrade), v. 21, no. 12, Dec. 1966 p 2052–2055 (JPRS-39544; TT-67-30194) CFSTI: HC $3.00/MF $0.65

The article discusses several types of sources of neutrons with their nuclear, physical, and chemical characteristics. It gives a short description of the procedures used in the production of neutron sources and indicates the feasibility of producing such sources by using a nuclear reactor. It also describes several of the most frequent forms of application of neutron sources. Author

N67-23467# Tokyo Univ. (Japan). Inst. of Physics.
ON RELATIONS BETWEEN TOTAL CROSS SECTIONS IN HIGH ENERGY
Haruichi Yabuki [1967] 4 p refs
CFSTI: HC $3.00/MF $0.65

A simple quark model has been successfully used to obtain relations between total cross sections which are in good agreement with observations. The same relations have also been reproduced from the algebraic method in the framework of the Regge-pole theory. An attempt is made to show that these two approaches are equivalent in the sense that their parametrizations of the total cross sections are equivalent to each other. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-21881*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PLASMA PHYSICS AND CONTROLLED THERMONUCLEAR FUSION
K. D. Sinel'nikov, ed. 1966 598 p refs Transl. into ENGLISH of the book "Fizika Plazmy: Problemy Upravlyaemogo Termoyadernogo Sinteza" Kiev, Akad. Nauk Ukr. SSR, Fiz.-Tekhn. Inst., n. 4, 1965 Proceedings of the 4th Conf. on Plasma Phys. and Controlled Thermonucl. Fusion, Kharkov, May 1963 Published for NASA and NSF
CFSTI: HC $3.00/MF $0.65 CSCL 20I

Papers on high-frequency properties of plasma, plasma–beam interaction, gas discharge, plasma stability, methods and diagnostics of plasmoids, plasma injectors, interaction of plasma with magnetic fields, shock waves in plasma, injection of plasma and beams of particles, magnetic traps, vacuum techniques, low-temperature, properties of metals, and plasma diagnostics are presented. For individual titles see N67-21882–N67-21959.

N67-21882*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE BEHAVIOR OF A PLASMA BOUNDARY HEATED BY ION CYCLOTRON WAVES
N. I. Nazarov, A. I. Ermakov, and V. T. Tolok *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 1–4 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A plasma, generated by resonance excitation of ion cyclotron waves, was studied for its decay mode by microwave interferometer at a wavelength of 8-mm. Since the density of the plasma was higher than the critical density for the 8-mm signal, the phase of the reflected signal indicated the position of the critical layer on the oscillogram. It was found that the plasma cylinder oscillated intensely when the amplitude of the ion cyclotron wave in the plasma was maximal. In magnetic fields below the resonance the reflected signal did not shift its phase noticeably; in resonance, phase shifts for a 3.2 cm signal ranged from $3\pi/2$ to 2π, which corresponded to a radial displacement of about 16 mm for a plasma layer with critical density. Comparison of the amplitude and signal phases reflected by various metal rods established that the critical plasma layer moved towards the center of the discharge tube. G.G.

N67-21883*# Israel Program for Scientific Translations, Ltd., Jerusalem.
A STUDY OF RESONANCE EXCITATION AND CERENKOV DAMPING OF HIGH-FREQUENCY PLASMA OSCILLATIONS
N. I. Nazarov, A. I. Ermakov, V. V. Dolgopolov, K. N. Stepanov, and V. T. Tolok *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 4–9 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Resonance excitation and damping of electromagnetic waves in a plasma cylinder in the presence of a strong longitudinal magnetic field were studied at frequencies less than electron cyclotron frequency and at electron gyrofrequency. Experiments with hydrogen and helium at pressures of 0.13 to 0.53 N/m^2 showed that for a given generator frequency, magnetic field strength, and excitation coil period, resonance occurs due to the variation of plasma density in time. Microwave interferometric measurements of plasma densities after high frequency pulses established rapid decay; tracing with a magnetic probe showed that the electron temperature increased fairly quickly and then remained stable despite an increase in the length of the heating pulse. This damping phenomenon was attributed to electron energy loss in the excitation of impurity atoms and ions with high ionization potentials. G.G.

N67-21884*# Israel Program for Scientific Translations, Ltd., Jerusalem.
CERENKOV ABSORPTION OF "WHISTLERS" IN AN INHOMOGENEOUS PLASMA COLUMN
V. V. Dolgopolov, A. I. Ermakov, N. I. Nazarov, K. N. Stepanov, and V. T. Tolok *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 9–15 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The damping of whistlers propagating along a plasma cylinder, and the possibility of heating of the electron component of the plasma with these waves was studied. Considered was a slow wave absorption of the energy of the electromagnetic field, generated by external azimuthal electric currents of known density. The electric and magnetic fields of the wave were determined and the current density in the plasma established. Amplitudes of the alternating magnetic field and the azimuthal electric field were then used to find the mean energy required by a single electron, the drift of the resonance electrons, and the equilibrium formation by energy absorption in the absence of electron collisions. Heating of the plasma was obtained by considering several waves with differing phase velocities and rapid thermalization of the energy acquired by the resonance particles. G.G.

N67-21885*# Israel Program for Scientific Translations, Ltd., Jerusalem.
EXPERIMENTAL STUDY OF THE ABSORPTION OF R-F ENERGY BY A PLASMA NEAR ION CYCLOTRON RESONANCE

M. P. Vasil'ev, L. I. Grigor'eva, V. V. Dolgopolov, B. I. Smerdov, K. N. Stepanov et al *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 15–25 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The absorption of radio frequency energy by a hydrogen plasma near the ion cyclotron resonance was studied by measuring the cross-section average electron density in the discharge tube, the electron temperature, and the ion temperatures. Results were compared with the theory for r-f energy absorption in a cold plasma near the ion cyclotron resonance; the halfwidth of the resonance power absorption curve agreed in its order of magnitude with the approximation theory. When ion resonance absorption of the r-f energy took place, almost the entire energy was transmitted to the cold plasma electrons, and the temperature of the ions remained balanced at 1 eV. G.G.

N67-21886*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CYCLOTRON RESONANCE IN AN INHOMOGENEOUS PLASMA COLUMN

M. P. Vasil'ev, L. I. Grigor'eva, V. V. Dolgopolov, B. I. Smerdov, K. N. Stepanov et al *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 25–30 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Considered was the high-frequency heating of a plasma column by external currents under conditions of ion cyclotron resonance, when plasma density and temperature vary along the radius. Assumed was that the plasma cylinder was immersed in a longitudinal magnetic field and that the high frequency field was formed by current density flowing in a thin coil enclosing the plasma columns. Calculations for a low-pressure plasma, where the magnetic pressure was much higher than the gas kinetic pressure created by the plasma particles, showed that the time-average flux of energy absorbed by unit length of plasma column broadened when density deviated from a "square" distribution. Absorption maximum for a square resonance distribution was much higher than for a distribution which falls off along the radius. G.G.

N67-21887*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A CONTRIBUTION TO THE THEORY OF HIGH-FREQUENCY HEATING OF HOT INHOMOGENEOUS PLASMA

V. V. Dolgopolov and K. N. Stepanov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 30–35 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Analyzed was the collisionless heating of a plasma column, whose density and temperature were functions of the radius, with an electromagnetic field set up by azimuthal electric currents passing outside the plasma. It was assumed that the magnetic pressure in the plasma was much greater than the gas-kinetic pressure and that the density and the temperature of the electron and ion components varied over distances greater than the particle Larmor radius. A net absorption of energy was found when the density of the plasma was zero and the heating of the plasma was enhanced by ion cyclotron resonance close to the velocity of sound. It was concluded that plasma heating by ion cyclotron resonance was more effective than magnetic pumping. G.G.

N67-21888*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ABSORPTION OF ELECTROMAGNETIC ENERGY BY AN INHOMOGENEOUS PLASMA IN MULTIPLE ION GYRORESONANCE

In its Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 35–38 (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Absorption of electromagnetic energy in an inhomogeneous plasma cylinder was analyzed by deriving expressions for the power absorbed by the plasma in the case of forced oscillations and for the damping ratio of free oscillations propagating along the plasma column. Oscillations were introduced by azimuthal electric currents flowing through a coil around the plasma cylinder. Gas-kinetic pressure was lower than the magnetic pressure, and the mean Larmor radius of the ions was less than the radius of the plasma column and the wavelengths of the plasma oscillations. Plasma current density was found by solving the kinetic equation for a small deviation of the equilibrium distribution function, and the ratio of energy acquired by a particle in Cerenkov resonance to the multiple cyclotron resonance. It was found that the latter was most effective in heating of low density plasmas. G.G.

N67-21889*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PROPAGATION OF ION CYCLOTRON WAVES IN A PLASMA IN THE PRESENCE OF A WEAKLY INHOMOGENEOUS MAGNETIC FIELD

K. N. Stepanov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 38–48 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The propagation of an ion cyclotron wave in the transition region between excitation and high absorption was studied. Considered was space dispersion of the plasma due to thermal motion of the ions and the cyclotron wave absorption by ions with their effects on resonance heating. Equations were formed and used to find the wavelength, the damping coefficient, and the phase and amplitude of the weakly inhomogeneous magnetic field as a dispersion function in oblique propagation. G.G.

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A CONTRIBUTION TO THE THEORY OF INTERACTION OF PARTICLES AND WAVES WITH A NONEQUILIBRIUM PLASMA

I. A. Akhiezer and Yu. L. Bolotin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 49–56 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

In the present paper we investigate the interaction of charged particles with nonequilibrium plasmas. If a plasma is close to instability, the cross section for the scattering of particles by the collective plasma oscillations and the loss of particle energy via Cerenkov radiation may be anomalously high. We also investigate the conversion of the transverse electromagnetic waves into longitudinal waves in interactions with critical fluctuations. The problem is also considered of the angular distribution of the scattered radiation in the interaction of plasma oscillations with critical fluctuations, and it is shown that under certain conditions the scattered intensity may be exceptionally high. Author

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EXCITATION OF A PLASMA WAVEGUIDE BY A COAXIAL WAVEGUIDE

S. S. Kalmykova and V. I. Kurilko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 56–59 (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Consider a semi-infinite cylindrical plasma-filled waveguide ($z>0$; $r\leq a$), used as an extension of the central core of a coaxial cable ($z<0$; $a\leq r\leq b$) and terminating with an ideally conducting diaphragm ($z=0$, $0\leq r\leq a$). A TEM wave propagates from the coaxial cable ($z<0$). Let us estimate the efficiency of excitation of the plasma waveguide by the coaxial waveguide. We substitute an anisotropic dielectric for the plasma waveguide and seek a solution for the scattered waves as a superposition of plane waves, each satisfying Maxwell's equations. Author

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A CONTRIBUTION TO THE NONLINEAR THEORY OF A PLASMA WAVEGUIDE IN A HIGH MAGNETIC FIELD

A. N. Kondratenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 60–64 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Performed was a nonlinear kinetic analysis of electromagnetic wave propagation in a plasma-filled cylindrical waveguide immersed in an infinitely strong magnetic field pointing along the waveguide axis. Hydrodynamic techniques were applied because the phase velocity of the wave was much higher than electron mean thermal velocity. The thermal motion was introduced by considering a pressure gradient in the equations of motion. Approximation methods established the fields and electron velocity in the plasma and evolved nonlinear dispersion equation for the continuous fields at the plasma-vacuum interface. G.G.

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NONLINEAR OSCILLATIONS IN AN INHOMOGENEOUS PLASMA IN THE PRESENCE OF A MAGNETIC FIELD

V. D. Shapiro *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 65–68 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Nonlinear plasma oscillations against an inhomogeneous background were analized by assuming that there were no thermal motions in the plasma, and that a uniform magnetic field was present in the YZ plane at an angle with the Z axis, which points in the direction of oscillation. Considered was the steady state case when the electron velocities were all zero and no electric field was present; variable motion equations were introduced and integrated. Results proved that the frequency of nonlinear plasma oscillations in the presence of a magnetic field was identical to the frequency of the linear oscillations. G.G.

N67-21894*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A CONTRIBUTION TO THE NONLINEAR THEORY OF CHARGE-DENSITY WAVES IN BEAMS WITH VARIABLE PARAMETERS

V. D. Shapiro *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 68–77 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The nonlinear theory of parametric excitation was used to analyze an infinitely broad beam of low percentage modulation that was homogeneous over its cross section. Time-dependent perturbations were imposed on the steady state velocity and flux of the streaming beam particles to introduce charge density fluctuations. Fluctuations propagating along the beam were then integrated into the steady stream formula and a solution was formulated that determined the velocity and number density of the beam. The characteristic feature of the above solution was a high oscillation amplitude in the instability zone. G.G.

N67-21896*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EFFECT OF ELECTRON THERMAL MOTION ON NONLINEAR PLASMA OSCILLATIONS

V. L. Sizonenko and K. N. Stepanov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 77–80 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The effects of the thermal motion of plasma electrons on the propagation of one-dimensional plasma oscillations was studied. Plasma oscillations were adiabatic with one degree of freedom because the phase velocity was higher than electron thermal speed. All variable quantities were assumed to be functions of a single variable and a formula for the nonlinear oscillation frequency was obtained as proof. It was shown that the nonlinear frequency varied with the amplitude of the electron thermal motion in nonlinear plasma oscillations. G.G.

N67-21896*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PENETRATION OF A LONGITUDINAL ELECTRIC FIELD INTO A BOUNDED PLASMA

V. F. Aleksin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 80–88 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

In the present paper, proceeding from the kinetic theory, we investigate the distribution of the electric field in a plane-parallel layer of electron–ion plasma immersed in an external monochromatic electric field directed at right angles to the walls. An expression is also derived for the energy lost by the electric field in the plasma. It is shown that for certain values of the plasma parameters and a certain frequency of the external field the plasma will resonate, maximizing the energy losses. It is assumed that the particles are specularly scattered at the plasma boundary, and that the strength of the alternating electric field remains fairly low. The second assumption justifies the application of the linear approximation. Author

N67-21897*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXCITATION OF ELECTROMAGNETIC WAVES IN A PLASMA BY EXTERNAL CURRENTS

V. F. Aleksin and K. N. Stepanov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 89–101 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

In the present paper we investigate the excitation of electromagnetic waves in an unbounded magnetoactive plasma by external currents utilizing the kinetic-theoretical approach. General expressions are derived for the fields set up by these currents in the plasma, and an expression for energy losses. The excitation of waves by azimuthal and axial currents modulated in the direction of the external magnetic field is treated in detail. In particular, the case of electron and ion cyclotron resonance and of "hybrid" resonances near which the thermal motion of the plasma electrons and ions cannot be neglected is considered. Author

N67-21898*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DIFFRACTION OF A SURFACE WAVE ON AN IDEALLY CONDUCTING WEDGE

S. S. Kalmykova and V. I. Kurilko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 102–104 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Consider the quarter-space $x>0$, $z>0$ filled with an anisotropic dielectric ($\epsilon_x = \epsilon_\perp, \epsilon_z = \epsilon_{\parallel}$) and having a common boundary with an ideally conducting rectangular wedge ($x>0$, $z<0$). We determined the field scattered by the wedge and, in particular, the amplitude of the reflected surface wave. Results apply to a plasma in the following case: in the presence of a constant magnetic field in the lower frequency region; and in the absence of a magnetic field. Author

N67-21899*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EFFECT OF RADIATION ON RESONANCE ACCELERATION OF PARTICLES

V. B. Krasovitskii and V. I. Kurilko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 104–106 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The effects of radiation on the self-resonance acceleration of particles, moving in the field of a plane wave in the presence of a homogeneous and constant magnetic field, was considered by linear and nonlinear motion approximations. An expression for the phase of particle velocity relative to the wave field was obtained that showed a displacement of the particle velocity phase relative to the field under radiation. G.G.

N67-21900*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTERACTION OF MODULATED HIGH-CURRENT PULSED ELECTRON BEAMS WITH A PLASMA IN A LONGITUDINAL MAGNETIC FIELD
A. K. Berezin, G. P. Berezina, L. I. Bolotin, Yu. M. Lyapkalo, and Ya. B. Fainberg *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 107–120 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

In the present paper we consider the results of experimental studies of the interaction of modulated high-current pulsed electron beams with a plasma in a longitudinal magnetic field. It is shown that under certain conditions, the initial modulation intensifies the plasma-beam interaction to a considerable extent. The field of the longitudinal waves excited in the beam and in the plasma is substantially smaller (approximately 1/7) than the field generated in the absence of modulation. The experiment results are interpreted. Author

N67-21901*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME PROPERTIES OF A POWERFUL PULSED ELECTRON BEAM EMERGING FROM A PLASMA SOURCE
E. A. Sukhomlin, V. A. Suprunenko, and N. L. Reva *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 120–121 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A powerful pulsed electron beam was obtained by a 30 kV discharge through the electrodes of a cylindrical tube containing a stabilized hydrogen plasma. The discharge current reached 100 kA, with a period of 9 μsec, and a pressure from 13.3 to 0.133 N/m^2. The electron beam transmitted through an 8 mm hole in the electrode and a dielectric channel onto a current detector. Measurements on the current of fast electrons established an abrupt stop at the 10 cm mark that was attributed to instabilities. A peak current was obtained for an initial pressure of 0.399 N/m^2, a magnetic field of 0.5 T, and an interelectrode voltage of 12 kV. G.G.

N67-21902*# Israel Program for Scientific Translations, Ltd., Jerusalem.
CHARACTERISTICS OF A PLASMA GENERATED BY AN ELECTRON BEAM WITH THE ONSET OF INSTABILITY
E. A. Kornilov, O. F. Kovpik, Ya. B. Fainberg, and I. F. Kharchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 122–127 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The onset of instabilities in an electron beam passing through a hydrogen plasma produced high-frequency oscillations in both, the beam and the plasma, so that the plasma density exceeded the beam density by several orders of magnitude. Experimental studies of the mechanism of plasma generation with the onset of instability and measurements of plasma parameters were performed on an electron beam of 2 to 5 KeV feeding into a glass envelope under pressure immersed in a magnetic field. A collector diaphragm with an analyzing grid was positioned at the outlet of the system. Measurements of beam energy emerging from the plasma showed that the beam stopped abruptly when the plasma density rose. Measurements of ion energies during plasma generation gave values of 40 to 200 eV for ion energy. It was assumed that the kinetic energy of the electron beam created the dense plasma. G.G.

N67-21903*# Israel Program for Scientific Translations, Ltd., Jerusalem.
AZIMUTHAL R–F FIELDS IN PLASMA-BEAM INTERACTIONS
V. D. Fererchenko, V. I. Muratov, and B. N. Rutkevich *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 128–130 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A moving screened loop set coaxially with an electron beam was used to measure axial and radial distributions of azimuthal radio-frequency fields created by beam-plasma interaction in the presence of a magnetic field. Correlation of their frequencies and spectra suggested that both fields were components of a single wave propagating along the axis of the beam. When the frequency of the oscillations was lower than electron cyclotron frequency, the motion of the electrons was adiabatic; the electrons moved together with the magnetic lines of force, which vibrated in the radial direction. Preliminary experiments indicated that the radial drift of particles was connected with the low frequency plasma oscillations that caused transverse electrical fields. G.G.

N67-21904*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE ELECTRIC FIELD IN THE COLUMN OF A HIGH-PRESSURE LONG ARC
R. V. Mitin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 131–135 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

One of the aims of our experiments with high-pressure long arcs was to study, and if possible to explain, the influence of the gas pressure p and the current I on the electric field E in the arc. The equations of the energy balance and Ohm's law in the discharge column were applied to explain the experimentally observed dependence. The limiting cases of high currents and pressures (radiation predominating) and of low currents and pressures (heat-conduction predominating) were approximately considered, and simple formulas were derived qualitatively explaining the results of the experiments. In the present paper we consider a general case, when both heat conduction and radiation must be introduced in the energy balance; the theoretical results are compared with the experimental data on helium arc and argon arc. Satisfactory agreement of theoretical and experimental data were found for both arcs in the region of intermediate pressure. Author

N67-21905*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE RADIATION OF A HIGH-PRESSURE ARGON ARC
Yu. R. Knyazev, R. V. Mitin, V. I. Petrenko, and E. S. Borovik *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 135–142 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Two new stabilization techniques for a long argon arc are described. One method uses an impeller mounted on a rotor shaft to rotate the gas in a high pressure chamber, and the other utilizes a continuous stream of argon blown tangentially into the discharge chamber for rotation. Experimental results showed that both methods obtained a steady arc column with a constant voltage gradient along the arc. Measurements of the heat quantity released at the electrodes did not vary much with increased arc length; the quantity of heat released at the walls and carried away by the circulating gas increased with arc length. Energy loss in above experiments was attributed to radiation along the entire arc. G.G.

N67-21906*# Israel Program for Scientific Translations, Ltd., Jerusalem.
MICROWAVE RADIATION FROM AN ELECTRODELESS INDUCTIVE DISCHARGE
I. Yu. Adamov, L. A. Dushin, V. I. Kononenko, and O. S. Pavlichenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 142–148 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The plasma of an electrodeless inductive discharge was experimentally and theoretically studied to find out whether it could produce microwave radiation from accelerated electrons whose bremsstrahlung registered as X-rays. Variation of the magnetic field inside and outside of a hydrogen plasma was recorded with magnetic probes, and plasma density and rate of growth were estimated from the attenuation of microwave signals transmitted

through the plasma. X-ray radiation was detected by scintillation elements and X-ray energy photomultipliers. It was shown that fast electrons formed along a helical trajectory to the center of the system, interacted with impurity ions in the dense plasma near the axis, and X-rays were emitted. As plasma density increased, oscillation shifted to higher frequencies and microwave radiation was registered as a result of longitudinal plasma oscillation conversion into transverse modes. Radiation was subsequently cut off due to compression heating of the ions. G.G.

N67-21907*# Israel Program for Scientific Translations, Ltd., Jerusalem.

QUASILINEAR THEORY OF INSTABILITY OF A PLASMA WITH ANISOTROPIC ION VELOCITY DISTRIBUTION

V. D. Shapiro and V. I. Shevchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 149–161 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The quasilinear theory of plasma instability was used to analyze aperiodic instabilities that arise when the longitudinal thermal energy of the plasma increased at the expense of the traverse energy, or vice versa, until the plasma reached a stable state. Assumed was that the initial deviation of the plasma parameters from the critical values was small. The dispersion equation of the ionic branch was used in the analysis; the plasma temperature in the state of saturation and the energy of the magnetic field generated were found. G.G.

N67-21908*# Israel Program for Scientific Translations, Ltd., Jerusalem.

QUASILINEAR THEORY OF APERIODIC INSTABILITIES FOR THE INTERACTION OF A BEAM WITH A PLASMA

V. G. Makhan'kov and V. I. Shevchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 161–167 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The interaction of a beam of charged particles with a plasma in the absence of a magnetic field gives rise to instabilities in the form of transverse electromagnetic waves propagating at right angles to the streaming velocity. Instabilities of this kind are connected with the anisotropy of the velocity distribution function in the plasma–beam system. These instabilities were investigated in the approximation of linear oscillation amplitudes and the authors determined the spectrum of the collective motions, the conditions of their excitation, and the growth increments in the initial stage. A characteristic feature of these instabilities is their aperiodicity. It was shown that the quasilinear theory can be applied to aperiodic instabilities. Author

N67-21909*# Israel Program for Scientific Translations, Ltd., Jerusalem.

VARIATION OF BEAM AND PLASMA PARAMETERS WITH THE ONSET OF CYCLOTRON INSTABILITY

V. D. Shapiro and V. I. Shevchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 167–172 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

In the present paper we consider the feedback from the oscillations excited when an ion beam, having an initial streaming velocity along the magnetic field and an initial transverse velocity interacts with a low-density cold electronic plasma; by feedback we mean the variation of the beam and plasma parameters (streaming velocity and thermal energy). Author

N67-21910*# Israel Program for Scientific Translations, Ltd., Jerusalem.

"DECAY" INSTABILITY OF WAVES IN A PLASMA WAVEGUIDE

A. N. Kondratenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 173–176 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Considered was the decay instability of waves in a cylindrical plasma waveguide immersed in an infinitely strong magnetic field where an infinity of wave vectors corresponded to any given frequency. A hydrodynamic system of equations describing the propagation of electromagnetic waves in the cylindrical plasma was formed, weak nonlinearity was assumed, and the fundamental harmonics were adopted as unperturbed solution to solve equations by successive approximation. Radial variation of the fields of the first and second order waves was obtained and their continuity at the waveguide boundary introduced in dispersion equation. It was shown that the decay of the initial wave into two waves of different frequencies was possible if the waves propagated in opposite directions. G.G.

N67-21911*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE DIFFERENCE BETWEEN ABSOLUTE AND CONVECTIVE INSTABILITIES AND BETWEEN AMPLIFYING AND EVANESCENT WAVES

R. V. Polovin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 176–179 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Amplifying oscillations are considered for a plasma perturbation $\phi(x,t)$ at a certain point $x=0$ for all t. This perturbation is represented as a Fourier integral with regard to all frequencies w. If for some real w, arbitrary perturbation k is complex, the oscillations are generally amplified; however, a complex k sometimes implies evanescence. This case was analyzed for a cylindrical waveguide at sub-critical frequencies by using the asymptotic perturbation formula $\phi(x,t)$ at $x=0$ and $t\to\infty$ to distinguish between the absolute and convective instabilities. G.G.

N67-21912*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ELECTRICAL CONDUCTIVITY OF A PLASMA WITH ELECTROSTATIC INSTABILITIES

E. A. Sukhomlin, V. A. Suprunenko, and N. I. Reva *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 180–184 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Electrical conductivity of a dense hydrogen–helium plasma immersed in an electric field was studied under conditions when processes associated with the generation of "runaway" electrons predominated. Used was a linear pinch discharge stabilized by the magnetic and electric fields from 10,000 to 100,000 V/m. The external magnetic field reached a strength of 7×10^{-1} T, and the current in the plasma was close to 100 kA with a period of 9 μsec. Measured were: interelectrode voltage, total current, the "runaway" electron current through a hole in the electrode, the temperatures of the ions and electrons and their densities, and microwave radiation at a wavelength of about 1.2 cm. It was found that the discharge resistance increased with the electric field and was connected with the onset of electrostatic instabilities that limited electron drift velocities. The onset of beam instabilities brought an abrupt drop of the "runaway" electron current and an intense emission of microwave radiation in critical electrical fields. Coulomb interactions were found insignificant. G.G.

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MACROSCOPIC INSTABILITY OF THE PLASMA IN A REFLEX DISCHARGE

O. S. Pavlichenko, L. A. Dushin, I. K. Nikol'skii, and L. V. Brzhechko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 184–190 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF$0.65

Diffusion of charged particles in a discharge plasma with nonconducting walls was studied for the pressure range from 1.33×10^{-2} to 1.33 N/m^2. The plasma was created in a glass discharge tube mounted on the axis of a coil system generating a homogeneous magnetic field of up to 2.7×10^5 A/m along the entire tube length. The initial vacuum in the system was 1.3×10^{-4} N/m^2, and basic results were obtained with helium at pressures from 6.6×10^{-2} to 1.3 N/m^2. Discharge current was measured by negative potential probe, charged particle density by double electric probe, electron temperature by He line intensities, and radial helium distribution by glow intensity. Also observed were microwave transmission and signal measurements with photomultipliers. The enhanced diffusion observed was accompanied by a decrease in plasma electron temperatures. In a plasma with oscillating electrons the enhanced diffusion resulted in increased thermal flow across the magnetic field. This anomalous diffusion of charged particles was attributed to the macroscopic motion of the column as observed in streak photographs and in measurements of the radial intensity distribution of helium. G.G.

N67-21914*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A METHOD FOR MEASURING THE ENERGY AND THE MASS SPECTRA OF THE IONIC COMPONENT OF A MOVING PLASMA

A. A. Kalmykov, A. D. Timofeev, Yu. I. Pankrat'ev, and V. I. Tereshin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 191–196 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Described is a drift mass spectrometer for the analysis of a beam of ions separated from a plasma. The low density ion beam is separated by a system of diaphragms, and directed to modulators where a single ion packet is isolated. After the beam passes through an electric analyzer it is deflected onto a detector. The distance between the modulator and the detector is the drift length. Since ions of equal energy but different mass traverse this distance in different times, the screen of an oscilloscope coupled into the detector will display the mass spectrum of the particle energies. Tests spectrograms of the ionic components of plasmoids generated by a button plasma source are included. G.G.

N67-21915*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PLASMA DIAGNOSTICS WITH A BEAM OF FAST PARTICLES

L. I. Krupnik and N. G. Shulika *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 197–204 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The parameters of a hydrogen plasma were measured by probing with a beam of fast neutral hydrogen atoms and ions. Alterations in the initial charge composition of the probing beam dependent on the species of the colliding particles, their relative velocity, number of particles in the target, as well as on the cross sections of the various processes contributing to the attenuation of the primary beam. Measurement results showed that no reliable data on the parameters of plasmoids can be obtained when the plasmoids contain more than 20% of heavy ion impurities. A plasma probe with a proton beam when the magnetic field in the chamber was nil detected atoms produced by charge exchange with the plasma. G.G.

N67-21916*# Israel Program for Scientific Translations, Ltd., Jerusalem.

AN INVESTIGATION OF A PLASMA SOURCE WITH A DRIFT MASS SPECTROMETER

A. A. Kalmykov, A. D. Timofeev, Yu .I. Pankrat'ev, and M. G. Nozdrachev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 206–210 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Mass and energy spectra of the ions in a plasmoid of a button-type plasma source were obtained by drift spectrometer. The ejected plasmoid was passed through diaphragms which emitted a thin beam; then the beam traveled through a separating device where the ion component of the plasmoid was separated, isolated, and directed to an electrostatic analyzer. The detector comprised an ion–electron converter and a scintillation counter. Ions of different masses traversed the drift space at different times and are time-resolved at the analyzer outlet since it admits ions of one energy only. The ionic current signal depended on the time of formation in the source and the time-resolution of the analyzer. Energy spectra of hydrogen for various modes of source operated showed that the creation and acceleration of a plasma in a button source occurred simultaneously. The length of the plasmoid was determined by the spread of particle velocities only and did not depend on the length of the source discharge. Characteristic mass distributions placed on the light ions in the head and the heavy ions in the tail of the plasmoid. G.G.

N67-21917*# Israel Program for Scientific Translations, Ltd., Jerusalem.

MEASURING THE ENERGY OF PLASMOIDS WITH THERMOPROBES

Yu. S. Azovskii, I. T. Guzhovskii, and B. G. Safronov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 210–212 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Total energy and radial energy distribution of plasmoids were determined by a thermocouple probe, comprising a pickup (a plane disk or a cylinder tube) with a thermocouple soldered to it. Energy plots registered by the thermocouple as a function of pickup depth, showed that any pickup geometry can be used; in absolute measurements, however, screened probes with a deep pickup are required. Excessively deep pickups impeded the heat transfer from the walls to the bottom of the cylinder. G.G.

N67-21918*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CREATION OF FAST PLASMOIDS WITH A COAXIAL SOURCE

A. G. Belikov, V. P. Goncharenko, V. M. Mishchenko, B. G. Safronov, and A. S. Slavnyi *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 212–218 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The possibility of creating plasmoids with velocities of $(4–8)\cdot10^7$ cm/sec concentrated on the parameters of a fast plasmoid and the conditions of its creation. The variable parameters were the source voltage, the time delay between the admission of gas through the valve into the interelectrode gap and the application of voltage to the electrodes, and the inflow of gas. Author

N67-21919*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ENERGY SPECTRA AND THE STRUCTURE OF PLASMOIDS IN A COAXIAL PLASMA SOURCE

A. A. Kalmykov, S. A. Trubchaninov, V. A. Naboka, and L. A. Zlatopol'skii *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 219–224 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A method for taking the energy and mass spectra of ions in plasmoids was applied to investigate some properties of plasma guns, in particular conical and button sources. These investigations give information on the mechanism of plasma acceleration in the source and, furthermore, provide detailed data on the composition and structure of plasmoids. All this is highly important for some problems connected with the injection of plasmoids into magnetic traps of various geometries. Author

N67-21920*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE GEOMETRY OF ELECTRODES AND ITS INFLUENCE ON THE PARAMETERS OF A PLASMA IN A COAXIAL GUN

A. A. Kalmykov, V. G. Marinin, F. V. Sivagin, and A. D. Timofeev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 224–229 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The effects of electrode length variations on plasma parameters were determined by mass spectroscopy with an extracting electric field and by microwave cutoff technique. The length of the inner electrode in a coaxial gun and the delay between the discharge of the valve-actuating bank and the discharge of the source capacitors were the variable quantities. The central electrode had the lengths of 0.018, 0.0325, 0.0675, 0.1015, and 0.1375 m; delay times varied from 220 to 600 μsec. Comparison of the energy distribution, mass composition, and number of fast particles in the various plasmoids observed showed that the number of particles of any given energy decreased as the electrode was made longer (the delay time remaining constant). G.G.

N67-21921*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF PROCESSES IN A COAXIAL PLASMA SOURCE

I. M. Zolototrubov, V. A. Kiselev, and Yu. M. Novikov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 229–236 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The mechanism of plasma acceleration was studied on a coaxial helium-filled gun with two copper electrodes. A magnetic probe measured the magnetic field inside the gun and the signal was integrated by an RC-circuit and fed to an oscilloscope. Experimental results showed that inside the coaxial gun the plasma displayed axial drift caused by the crossed electric and magnetic fields behind the current sheet. During most of the first half-period of the current the drift velocity pointed in the direction of motion of the current sheet; reversal of drift velocity impels the plasma toward the insulator. The second spark through the interelectrode gap and the shortening of the electrodes near the insulator were connected with this reversed motion. G.G.

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MASS-SPECTROMETRIC INVESTIGATION OF A CONICAL SOURCE OF SIMPLIFIED DESIGN

L. I. Krupnik and N. G. Shulika *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 237–239 ref (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A thick-walled conical glass body was used as plasma source and its performance was studied by mass spectrometer. The source functioned without failure at voltages of 25 kV and higher, was durable, and did not break in forced mode of operation. Mass spectra of plasmoid ions in various modes of source operation showed that high purity hydrogen plasmas were obtained with this conical source. G.G.

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A CONICAL PLASMA SOURCE WITH ELECTRODES AND PULSED GAS INLET

Yu. S. Azovskii, I. T. Guzhovskii, and B. G. Safronov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 239–244 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A conical glass plasma source with electrodes and pulsed helical return conductor was studied for its performance and the parameters of the ejected plasmoids. Mass composition of the plasmoids was determined for various delay times and source voltages and listed in tables. It was found that the gun ejected multiple plasmoids during the first half-period of the discharge current; this was attributed to the onset of radial oscillations and pinching of the discharge of the source. Microwave probing of the plasmoids resulted in a complete signal cutoff; this indicated charged particle densities of more than 1.7×10^{13} cm−3. It was concluded that the obtained plasmas were of high purity but apparently of smaller density and somewhat slower since the damping factor was dominated by interactions with the glass wall. G.G.

N67-21924*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ENERGY SPECTRA OF THE CONICAL PLASMA SOURCE WITH ELECTRODES

A. A. Kalmykov, V. I. Tereshin, and N. S. Poltavtsev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 245–251 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Hydrogen plasmoids from a conical plasma gun were analyzed by drift spectrometer to establish the composition and energy distribution of plasmoid particles. It was found that the ionization time of the particles was small in comparison with the discharge period of the condenser and that the plasmoid carried impurity ions of C^{3+}, C^{2+}, N^{2+}, O^{2+}, C^{+}, N^{+}, O^{+}, F^{+}, Si^{+}, and Cu^{+}. Energy distribution of the protons and impurity ions for various modes of source operation showed that a slow hydrogen plasmoid and two fast plasmoids carried about the same number of particles. G.G.

N67-21925*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE GENERATION OF FAST PARTICLES IN A PLASMA SOURCE

A. A. Kalmykov, Yu. I. Pankrat'ev, and M. G. Nozdrachev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 251–258 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A button-type plasma source was used to investigate the influence of various factors, e.g., source geometry and electrical parameters of the discharge circuit, on the creation and acceleration of fast particles. Moving plasmoids were analyzed by drift mass spectrometer and energy distributions were plotted for plasma ions with different masses of particle. Angular distribution measurements of emerging particles proved that particles of higher energies moved in a progressively narrow solid angle, while the slow particles displayed almost isotropic angular distribution. As the plasmoid moved down the system, the losses of slow particles to the wall were therefore much higher, and the energy distribution highly sensitive to the distance from the source. Creation and acceleration of fast particles were found essentially independent of source geometry and discharge circuit parameters. G.G.

N67-21926*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INTERACTION OF PLASMOIDS WITH TRANSVERSE MAGNETIC FIELDS

I. I. Demidenko, V. G. Padalka, B. G. Safronov, and K. D. Sinel'nikov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 259–267 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Interaction of a plasma with a transverse magnetic field was studied and plasma parameters were determined for transverse and longitudinal motions by plasmascopes moving along the axes. Photographs showed that a plasmoid injected into a transverse magnetic field deflected toward the positive or negative axis, depending on the actual direction of the magnetic field. A pure hydrogen plasma could not be injected into the transverse magnetic

field but was readily captured by very weak magnetic fields. A plasma of conical source containing all the heavy ion impurities passed through the transverse fields fairly easily. G.G.

N67-21927*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTERACTION OF DENSE PLASMOIDS WITH A SPACE-PERIODIC MAGNETIC FIELD
A. A. Kalmykov and V. I. Tereshin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 267–273 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The interaction of comparatively dense plasmoids ($\approx 10^{20} \times 10^{21}$ m^{-3}) with space-periodic magnetic fields was studied to establish the existence of resonance. A drift mass spectrometer was used to take the proton energy spectra; energy distribution of protons in plasmoids passing through a modulation field, and without modulation, showed that near the energies of 45 to 55 eV ($0.93-1.02 \times 10^5$ m/sec) the difference in energy spectra was greatest; the deviation clearly established resonance mechanism. Microwave measurements under the same conditions found delayed cutoff of electromagnetic waves when modulation was turned on. This cutoff lengthening was attributed to the reflection of dense particles from the magnetic barrier. It was concluded that high-density plasmoids, having a large kinetic-to-magnetic pressure ratio, showed considerable conversion of translational particle energy upon interaction with space-periodic magnetic fields. G.G.

N67-21928*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PENETRATION OF PLASMOIDS THROUGH A MAGNETIC BARRIER IN THE PRESENCE OF R-F FIELDS
I. I. Bakaev, Yu. G. Zaleskii, N. I. Nazarov, V. T. Tolok, and A. M. Ukrainskii *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 274–276 refs (See N67-21881 11-25) (CFSTI: HC$3.00/MF$0.65

The penetration of plasmoids through a magnetic mirror in the presence of an r-f field was studied on a conical source plasmoid ejected from a region close to a zero magnetic field. An induction coil generated a space-periodic field with a wavelength of 20 cm and fed the r-f energy into the plasmoid. A diamagnetic probe traveling along the solenoid axis measured the influence of the r-f field on the penetration of the plasmoid through the magnetic mirror and gave the amplitude of the diamagnetic signal as a function of the magnetic field when the r-f field was turned off. Signal attenuation in the mirror and its amplification in the trap showed that the absorption of r-f energy by a plasmoid had a considerable influence on its capture. G.G.

N67-21929*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE BEHAVIOR OF DENSE PLASMOIDS IN A LONGITUDINAL MAGNETIC FIELD
L. I. Krupnik, N. G. Shulika, and P. A. Demchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 278–280 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

A method for the probing of a plasma by a beam of fast neutral hydrogen atoms makes it possible to measure with fair accuracy the density of the plasma intercepted by the beam, as well as its distribution in time and in space. After the first satisfactory results had been obtained, the method of plasma probing with a neutral beam was applied to investigate the various modes of operation of the conical plasma source with pulsed hydrogen inlet used in experiments, and also the behavior of dense plasmoids moving in a longitudinal magnetic field. Author

N67-21930*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTERACTION OF SMALL PLASMOIDS WITH EXTERNAL MAGNETIC FIELDS
N. A. Khizhnyak *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 281–286 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The model of a flexible current-carrying loop is applied to describe the interaction of small plasmoids with external magnetic fields. The interaction of a plasma stream with external fields can also be described within the framework of magnetohydrodynamics. In this paper we show that the equations of the flexible loop model are equivalent to the magnetohydrodynamic equations, from which they can actually be derived; in some particular cases, however, they are much more convenient in application than the equations of hydrodynamics, as they reduce the problem to one in ordinary differential equations. Author

N67-21931*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE MOTION OF PLASMOIDS IN A HELICAL MAGNETIC FIELD
V. S. Voitsenya, B. P. Il'enko, E. M. Lats'ko, I. N. Onishchenko, B. G. Safronov et al *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 286–292 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The motion of plasmoids along the magnetic field of a toriodal solenoid with helical winding and the loss of particles to the walls of the plasma guide were studied on a hydrogen plasma injected into a chamber with helical winding; the radius of the helix was 5.4 cm, pitch angle 0.24 rad, and maximum current up to 2200 A. It was established that helical magnetic fields had no detrimental effects on the separation of heavy impurities from the plasmoids but improved the transmission of the plasmoids by a factor of 6. G.G.

N67-21932*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE REFLECTION OF A PLASMA STREAM BY A MAGNETIC FIELD
A. M. Kovalev and N. A. Khizhnyak *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 293–298 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Analyzed was the reflection of a quasineutral plasma from a magnetic wall under neglect of interparticle collisions. Assumed was an electric polarization field, pointing along the x axis, and an additional magnetic field set up by the motion of charged particles in the boundary layer. The steady state equations of motion for the ions and electrons in the magnetic field were integrated with respect to time and movement away from the plane of injection and their potential in the boundary layer. It was shown that the induced magnetic field was of no significance if the injection velocity of the plasma did not exceed a certain limiting value. The penetration depth of the plasma in a magnetic field was determined by the penetration depths of its ions and electrons. G.G.

N67-21933*# Israel Program for Scientific Translations, Ltd., Jerusalem.
REFLECTION OF PLASMOIDS FROM A METALLIC SURFACE
L. I. Krupnik, N. G. Shulika, and P. A. Demchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 298–304 ref (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The reflection of plasmoids was studied by a probing beam of fast neutral and charged particles which intercepted the plasmoid and was then directed to a metallic surface. The distance of the metallic screen from the plasma-beam encounter was variable. Velocity of the reflected plasmoid was estimated from the time

shift of the reflection interference for various screen positions. Transition time of the reflected plasmoid registered for the head of the plasmoid without any distortion due to the reflected signal; reflection was distorted only by the thinner plasma tail. G.G.

N67-21934*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SELF-INDUCTANCE OF AN ELLIPSOIDAL PLASMOID
N. A. Khizhnyak and K. P. Cherkasova *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 304–308 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Self-inductance calculations for oblate and prolate plasma ellipsoids of revolution impinging on a magnetic field were performed by using the self-inductance component of the electronic component of the plasmoid to characterize electron angular velocities to expand the reciprocal distance in a series of self expansions. G.G.

N67-21935*# Israel Program for Scientific Translations, Ltd., Jerusalem.
A CONTRIBUTION TO THE THEORY OF COLLISIONLESS SHOCK WAVES
R. V. Polovin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 309–315 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

In this paper we investigate the structure of a collisionless shock wave [quasi-shock] in a plasma immersed in a magnetic field. The thermal energy behind the shock wave is concentrated in ionic sound waves generated at the shock front by the reverse mechanism of Landau damping. Nonlinear interaction of waves leads to random, i.e., thermal, oscillations. The structure of the shock wave is ergodic. This means that infinitesimal fluctuations of the magnetohydrodynamic quantities in front of the shock wave first exponentially grow and then start pulsating at random, without returning to the initial state. Averaging over these pulsations, we find the effective heating. It is shown that this process enhances the rate of thermonuclear reactions. The relaxation length is found to be equal to the Debye radius. Author

N67-21936*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE INTERACTION OF PLASMA STREAMS IN A TRANSVERSE MAGNETIC FIELD
V. G. Zykov, N. G. Sinitsa, I. A. Stepanenko, V. T. Tolok, and K. D. Sinel'nikov *In its* Plasma Phys. Controlled Thermonucl. Fusion 1966 p 316–325 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The present work is a study of the collision of fast plasma streams with thermalization of the kinetic energy of their streaming motion. The Coulomb interactions between colliding particles are apparently inadequate in this case, since plasmas with densities of 10^{16} cm^{-3} and stopping lengths of no more than 1 m are required to ensure sufficiently high temperatures (10^{6}°K) by random motion only. It is therefore interesting and advisable to consider the so-called polarization interaction of the plasma streams moving across a magnetic field. The motion of plasmas in transverse magnetic fields was successfully studied. However, these experiments did not ensure proper collision of the plasmoids, and this had a detrimental influence on the efficiency of stopping. Author

N67-21937*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INJECTION OF PLASMA IN A QUADRUPOLE MAGNETIC FIELD
Ya. F. Volkov, V. A. Kornilov, and V. G. Dyatlov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 326–331 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

We investigated the motion of a plasma stream injected by a coaxial gun into the magnetic field of a quadrupole lens. This is a field of cusped geometry, and the plasma in this field should be stable with respect to flutes. Some earlier experiments confirm this fact. The quadrupole field focuses charged particles of opposite signs in mutually perpendicular planes. However, the motion of a plasma in this geometry is hardly predictable. To interpret the interaction of a plasma jet with a quadrupole magnetic field, we determined the parameters of the plasma as a function of the operating mode of the gun. Author

N67-21938*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INJECTION OF PLASMA INTO A MAGNETIC TRAP WITH CUSPED FIELDS
I. M. Zolototrubov, N. M. Ryzhov, I. P. Skoblik, and V. T. Tolok *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 332–334 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A hydrogen plasma was injected into a magnetic trap with cusped fields and the time-dependence of the X-ray radiation emitted on injection was observed by a CsI crystal coupled into a photomultiplier and oscilloscope. Radiation energy picked up by the crystal was measured by X-ray film. Obtained results showed that: (1) when plasma was injected into the trap from a coaxial gun operating with small delay times, intense X-ray radiation was observed 840 μsec after injection; (2) this radiation was the bremsstrahlung of charged particles escaping through the magnetic slit; and (3) the X-ray energy (3.8 keV) was equal to the energy of hydrogen ions residing in the head of the injected plasmoid. G.G.

N67-21939*# Israel Program for Scientific Translations, Ltd., Jerusalem.
MOTION OF CHARGED PARTICLES IN MAGNETIC TRAPS OF CUSPED GEOMETRY
K. D. Sinel'nikov, N. A. Khizhnyak, N. S. Repalov, P. M. Zeidlits, V. A. Yamnitskii et al *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 335–348 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The motion of charged particles in magnetic traps of cusped geometry was analyzed by defining the magnetic fields of a cusp trap as the central region between two ring currents, and then obtaining their particle trajectories by numerical integration of the equations of motion. The following conclusions were obtained: (1) Particles injected along the trap escape freely if the injection radius is less than 0.7 R_L; particles reflected from the opposite mirror may remain in the trap for a brief time and reside mainly in the mirrors; (2) the trapped particle is repeatedly reflected from the magnetic walls and escapes mostly through the ring slit; the number of reflections depends on the magnetic field; and (3) the residence time of the particles in the trap is comparable with the free drift time. G.G.

N67-21940*# Israel Program for Scientific Translations, Ltd., Jerusalem.
EXPERIMENTAL INVESTIGATION OF THE MOTION OF CHARGED PARTICLES IN MAGNETIC TRAPS OF CUSPED GEOMETRY
K. D. Sinel'nikov and B. S. Akshanov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 348–354 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Charged particle motion in magnetic traps of cusped geometry was studied by tracing the trajectories of the injected electrons in a vacuum system with various screen combinations. These screens at the opposite ends of the tube were coated with phosphorescent substances and could be rotated or displaced axially down the chamber until they almost touched the gun. Electron paths, some

showing five-fold reflection, were observed visually with good reproducibility. It was found that the particle motion in the trap was substantially influenced by the position of the gun; the distance of the gun from the z axis had a very strong effect on the position of the plane of reflection and the trap volume. If the field beyond the second magnetic mirror was uniform, and the beam energy somewhat higher than the maximum reflection energy, the beam penetrated through tracing a very tight helix. The nearer the particle energy to reflection energy, the smaller the helix pitch. Experimental injection of helical beams into a magnetic-mirror trap produced a fairly dense ($n \approx 10^{12}$ cm^{-3}) long-lived ($\tau \approx 0.1$ sec) plasma. G.G.

N67-21941*# Israel Program for Scientific Translations, Ltd., Jerusalem.

AN INVESTIGATION OF A NONADIABATIC MAGNETIC TRAP

A. P. Slabospitskii, V. D. Fedorchenko, and B. N. Rutkevich *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 354–359 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Studied was the motion of charged particles in a space-periodic magnetic field and their interactions with this field that converted longitudinal injection energy to the energy of transverse motion. Phosphor-coated screens were used to measure the displacement of the beam image from the magnetic trap axis after the electrons were injected by a hot cathode electron gun mounted outside the magnetic field region. A bright-up reticle was placed behind the screen so that beam displacement from the axis would be measured with an accuracy of 0.002 m. It was found that in resonance no less than 70% of the longitudinal energy of the particles converted into the energy of transverse motion. G.G.

N67-21942*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL INVESTIGATION OF A CLOSED MAGNETIC TRAP

A. P. Slabospitskii and V. D. Fedorchenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 360–364 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

The circulation of charged particles in a closed magnetic trap was studied experimentally for conversion of transverse energy into longitudinal energy. Application of phosphorescent screens showed that an appropriate choice of the distance from the space-periodic field region and the angle between the particle velocity vector and the magnetic line of focus ensured effective conversion of the greater part of transverse particle energy into longitudinal energy. An outward growth of the radial magnetic field component in the space-periodic field region broadened the resonance curve and enhanced particle conversion. The resonance effect of one-turn helical coils displaced the particles from the axis in the drift plane at varying longitudinal energies. G.G.

N67-21943*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A MAGNETIC TRAP WITH A STRONG MAGNETIC FIELD

E. S. Borovik, F. I. Busol, V. A. Kovalenko, V. B. Yuferov, and E. I. Skibenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 364–372 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Described are layout and main components of a magnetic trap with cryogenic-cooled coils for the generation of high magnetic fields by injection of high-intensity beams of fast neutral hydrogen or deuterium atoms. The coils were fabricated from copper wire and were cooled by liquid hydrogen; the entire magnetic system was enclosed in a large vacuum chamber leaving a helium condensation pump for leaking hydrogen evacuation. Hydrogen ion beams were produced by an ion source attached directly to the charge-exchange chamber so that a mixed beam of hydrogen ions hit the target. Charge exchange was achieved by intercepting the accelerated beam of hydrogen ions with a supersonic CO_2 jet. Measurements of the degree of ionization showed that the trapping efficiency of fast ions in this process exceeded the trapping efficiency by residual-gas ionization at pressures of some 10^{-7}N/m^2. Magnetic trap system tests for a 5 cm diameter geometry and a pulse length of nearly 1 sec generated fields of 10 T at the center of each single coil. G.G.

N67-21944*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A CALCULATION OF THE FILLING OF THE GVL-2 TRAP WITH PLASMA

E. X. Borovik, F. I. Busol, and K. D. Sinel'nikov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 372–380 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Performed were calculations on the filling of a small-capacity magnetic trap, having cryogenically cooled coils, with a high magnetic field. A schematic diagram of the magnetic system and some magnetic field distribution data were given, and axial field distributions and the contours of the paraxial line of force were obtained. The rate of plasma build-up and maximum density was evaluated by the following methods: (1) enhancement of trapping by magnetic field of suitable geometry; (2) reduction of the effective Coulomb scattering cross section; and (3) reduction of charge-exchange cross section and increase of ionized cross section in a high magnetic field. G.G.

N67-21945*# Israel Program for Scientific Translations, Ltd., Jerusalem.

POLARIZATION OF PLASMA MOVING IN A HELICAL MAGNETIC FIELD

B. P. Il'enko, V. G. Zykov, E. M. Lats'ko, and V. M. Zalkind *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 380–388 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

A three-turn helical winding, fitted into a vacuum chamber and bent into a semitorus with 42 cm mean radius of curvature, was used to determine experimentally the polarization electric field in a plasmoid moving in a combined toroidal and helical magnetic field. Polarization field vector was measured with flat probes provided along the curved section and oscillograms of the signals for opposite longitudinal magnetic fields; the gun discharge current was maintained at floating potential. It was found that the polarization of a plasmoid moving in a curved magnetic field is a function of its translational velocity. If the plasma is highly conductive, the polarization fields are relieved by currents flowing along the magnetic lines of force and the fast plasmoid component is partly detached from the slow component; the resulting poor conductivity between the head and the tail leads to retention of some residual polarization in the head of the plasma. G.G.

N67-21946*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ROTATION OF PLASMA WITH SUPERCRITICAL VELOCITY

O. M. Shvets, S. S. Ovchinnikov, and V. F. Tarasenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 388–391 refs (See N67-21881 11-25) CFSTI: HC $3.00/MF $0.65

Investigations of the magnetic containment of plasma and generation of high-temperature plasma by thermalization of the rotational kinetic energy require drift velocities. Preliminary experiments showed that high drift velocities could not be attained simply by increasing the radial field strength. The velocity did not rise above the critical value. Various hypotheses were advanced by both experimental and theoretical physicists to explain this curious phenomenon. Author

N67-21947# Israel Program for Scientific Translations, Ltd., Jerusalem.
A STUDY OF MAGNETIC SURFACES IN A SYSTEM WITH TRIANGULAR WINDINGS
B. S. Akshanov, A. I. Strel'tsov, and Yu. N. Gurov *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 391–396 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Magnetic measurements and electron beam probing were performed on a moderated stellarator magnetic system comprising a solenoidal coil wound onto a triangular-shaped base frame. The base was axially twisted to provide the desired pitch and then shaped into a torus. Comparative tests on a triangular-shaped arrangement and a conventional three-turn helical coil established similar characteristics in the straight and curved sections. The magnetic field in the triangular winding was very pure and reduced the penetration of external fields. G.G.

N67-21949*# Israel Program for Scientific Translations, Ltd., Jerusalem.
TRAPPING OF H^+ IONS IN STAINLESS-STEEL SURFACES
E. S. Borovik, N. P. Katrich, and G. T. Nikolaev *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 402–408 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Reported are trapping efficiency measurements for 35 keV hydrogen ions H_1^+ in a target of stainless steel. A high-frequency ion source with electrostatic lens provided a well focused beam of H_1^+ ions of up to 120 μA, which gave a target current density of 160 $\mu A/cm^2$. Trapping measurements were plotted as a function of the concentration of imbedded hydrogen, of the amount of hydrogen in the chamber, and also determined by weighting. It was found that the trapping efficiency of 35 keV H_1^+ ions by a clean surface of stainless steel is over 93% up to concentrations of 2×10^{19} trapped particles per cm^2. G.G.

N67-21954*# Israel Program for Scientific Translations, Ltd., Jerusalem.
A CONTRIBUTION TO THE THEORY OF TRANSFORMATION AND SCATTERING OF ELECTROMAGNETIC WAVES IN A NONEQUILIBRIUM PLASMA
I. A. Akhiezer, I. A. Daneliya, and H. L. Tsintsadze *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 428–434 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Scattering calculations for an extraneous longitudinal wave in a nonequilibrium plasma are presented, as well as its conversion into a transverse wave by critical plasma fluctuations. The amplitude of the secondary wave produced by the interaction of two waves propagating in the plasma was developed from the Boltzmann kinetic equation for particles and Maxwells equations. This was followed by transformation and scattering analysis for waves in a nonisothermal plasma with the electron drift velocity close to the phase velocity of a two-temperature sound. Finally considered was the transformation of plasma waves by a beam of critical velocity close to the critical velocity for Langmuir waves. G.G.

N67-21955*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PLASMA DIAGNOSTICS UTILIZING THE SCATTERING OF ELECTROMAGNETIC WAVES
O. S. Pavlichenko and L. A. Dushin *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 435–442 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

Plasma probing by analysis of incoherent scattered electromagnetic waves in the microwave and optical region was evaluated. Under certain conditions, the spectrum of the scattered signal was broadened by the thermal motion of the ions and thus indicated the ion plasma temperature. Optimal choices of probing frequency and powers were obtained for plane waves incident on a plasma volume, acoustic wave propagation in a nonequilibrium plasma and a current-carrying plasma, and a plasma with a beam. Experimental investigations of ruby laser scattering in plasmas gave an acceptable signal-to-noise ratio for the 100 kW range and schemes with multiple passage of the light beam through the plasma. Experiments in the microwave region established that the scattering of millimeter waves in a plasma is governed by collective effects; spurious scattering effects were attributed to thermal equilibrium radiation and bremsstrahlung. G.G.

N67-21956*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PLASMA DIAGNOSTICS UTILIZING THE EXTRAORDINARY TRANSVERSE WAVE
L. A. Dushin, V. I. Privezentsev, and A. I. Skibenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 443–445 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

If we examine the variation of permittivity and of the phase and damping coefficients as a function of plasma density, it becomes obvious that the extraordinary wave is highly suitable for estimating both the plasma density and the collision frequency. The most successful technique calls for simultaneous application of the ordinary and the extraordinary transverse waves, where the measurements are mutually complementary. This is also convenient in technical respects, since the plasma is in fact probed with waves of one frequency, but different polarizations. Author

N67-21957*# Israel Program for Scientific Translations, Ltd., Jerusalem.
MICROWAVE PLASMA DIAGNOSTICS UTILIZING LONGITUDINAL PROPAGATION OF RADIO WAVES
L. A. Dushin, V. I. Privezentsev, and A. I. Skibenko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 450–455 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The application of longitudinal propagation of radio waves for the diagnostics of a plasma in the presence of an external magnetic field considerably expands the measurable range of some plasma parameters. We concentrated on the influence of the collision frequency on the measurements of plasma parameters. From the refractive index of a collisionless plasma we can determine the frequency range of the radio waves being used, as a function of plasma density and magnetic field. In the presence of magnetic fields stronger than the resonance field the plasma may propagate extraordinary waves at any density. The influence of collisions is thus felt in the range of low frequencies (in comparision with the plasma frequency). The applicability of the ordinary wave is much more restricted, and it does not differ much from the applicability in the case of transverse propagation. Author

N67-21958*# Israel Program for Scientific Translations, Ltd., Jerusalem.
MICROWAVE AND SPECTROSCOPIC INVESTIGATION OF AN ELECTRODELESS INDUCTIVE DISCHARGE
L. A. Dushin, V. I. Kononenko, O. S. Pavlichenko, V. K. Nikol'skii, and L. V. Brzhechko *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 456–461 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

A hydrogen plasma, generated by an 18.6 μF capacitor bank discharge through a single-loop coil and escaping from the coil enclosure along the axis was probed with microwave signals at 9.4×10^9 c/s, 37×10^9 c/s, and 140×10^9 c/s. Oscillograms of the microwave signals transmitted through the plasma found a density of over 2.4×10^{14} cm^{-3} and a life of 80 μsec inside the coil. Cutoff measurements of signal times at various frequencies were plotted as density variation times for charged particles inside the coil and distance from midplane for various capacitor discharge voltages. Density decay curves outside the coil corresponded to a diffusion mechanism, while the escape mechanism inside the coil was considerably faster. Analysis of reflected signal oscillograms showed that in the presence of a magnetic field, the plasma

inside the coil oscillated in the radial direction at twice the frequency of the magnetic field. Spectroscopic measurements showed increased plasma density with discharge voltage and electron temperature increases. At elevated pressure, ionic sound oscillations may be excited in the plasma. G.G.

N67-21959*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SPECTROSCOPIC INVESTIGATION OF COLLIDING PLASMOIDS
V. G. Zykov, I. A. Stepanenko, L. A. Dushin, I. K. Nikol'skii, O. S. Pavlichenko et al *In its* Plasma Phys. and Controlled Thermonucl. Fusion 1966 p 461–467 refs (See N67-21881 11-25) CFSTI: HC$3.00/MF$0.65

The present paper is a continuation of a series of researches devoted to processes of capture and retention of plasma injected into a system with oppositely directed magnetic fields; the interactions of plasmoids colliding in the absence of a magnetic field are also studied. We deal with the spectroscopic phenomena attendant on plasmoid interaction, and also give measurements of the ion temperature of the plasma created by plasmoid collision. Author

N67-22133# California Univ., Livermore. Lawrence Radiation Lab.
RADIATION AND PLASMA PHYSICS
In its Phys. Dept. Progr. Rept. Jan. 1966 p 37–48 refs (See N67-22130 11-24) CFSTI: HC$3.00/MF$0.65

Brief summaries of research are presented for the following: electromagnetic mass of the electron, many-atom effects in laser radiation, momentum transfer produced by focused laser giant pulses, nanosecond Q-spoiled laser pulses, frequency-dependent radiation transport, numerical computation of stellar dynamics, and plasma transport theory. NSA

N67-22143*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VORTEX ARC STUDIES
Stanley Neuder *In its* Radiometry Res. Mar. 1967 4 p (See N67-22141 11-11) CFSTI: HC$3.00/MF$0.65

Measurements of the spectral distribution of vortex stabilized, inert gas plasmas and mixed inert gas plasmas, continue to be made with the vortex stabilized arc (VSA) in order to attain an improved externally-unmodified, single source of solar simulation. Author

N67-22166*# Pennsylvania Univ., Philadelphia.
FLOW OF A CONDUCTING LIQUID IN AN ANNULAR GAP: A RESTRICTED NONEXISTENCE PROOF
S. Schweitzer and I. M. Cohen *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 7 p refs (See N67-22161 11-03) CFSTI: HC$3.00/MF$0.65

A mathematical analysis is presented for the problem of a liquid conductor confined between two concentric cylindrical electrodes, with the liquid metal electromagnetically accelerated by the Lorentz force when a current is passed between the two electrodes. The governing equations are identified as the coupled momentum and Maxwell equations. The boundary conditions are discussed, and it is concluded that the assumptions of steady state, inviscid flow with constant properties and axial symmetry must be regarded with caution. N.E.N.

N67-22307# California Univ., Livermore. Lawrence Radiation Lab.
A ONE-DIMENSIONAL MAGNETOHYDRODYNAMICS CODE
Daniel Steinberg 7 Jun. 1966 48 p refs
(Contract W-7405-ENG-48)
(UCRL-14931) CFSTI: HC$3.00/MF$0.65

A description of MAGPIE, a one-dimensional magnetohydrodynamic code which includes thermal diffusion—both heat conduction and radiation flow is presented. It was designed to operate in cylindrical geometry and can treat either the H(z) or H(θ) case, but not both simultaneously. It can approximate a 1-D Cartesian system by taking as the first zone a void with a large radius. Provision has been made in the code to include an external RLC circuit in which it is possible to short-circuit, or crowbar, the capacitor when its charge reaches zero. NSA

N67-22449# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
NUMERICAL TREATMENT OF NON-IDEAL MGD BASIC EQUATIONS
H. Friedel 15 Jun. 1966 14 p refs
(Contract AF 61(052)-675)
(SR-33; AD-643163) CFSTI: HC$3.00/MF$0.65

The mathematical treatment of the MGD basic equations is rendered extremely difficult by dissipation terms, as, e.g., caused by thermal conductivity, internal friction of finite electrical conductivity of the medium. Such terms give rise to a parabolic degeneration of the otherwise hyperbolic equations and, consequently, exclude the application of the method of characteristics which is usually used in the non-dissipative case. Summarizing the treatment of a previous report, and generalizing some of its results, a numerical method of solution for the parabolically degenerated one-dimensional MGD basic equations is given; it has been developed in analogy to the theory of characteristics. This method is advantageous insofar as it has - particularly for weak dissipation - similar stability properties as the method of characteristics (in the case of vanishing dissipation). Using this numerical method, the unsteady development of the structure of a magnetically driven shock under the influence of finite electrical conductivity is investigated in MGD--($B << 1$)-approximation. The ($B << 1$)-approximation was chosen since it leads to a particularly simple and perspicuous form of the basic equations. TAB

N67-22488# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati.
EXPLOSIVE TECHNIQUES FOR APPLICATIONS IN EXPERIMENTAL PHYSICS
F. Herlach and H. Knoepfel Jul. 1965 61 p refs Sponsored in part by EURATOM
(LGI-65-17) CFSTI: HC$3.00/MF$0.65

Explosive experimental techniques used in magnetic flux compression experiments are described. These include the fabrication of precise explosive charges and their initiation. The acceleration of metallic liners by high explosives is treated. Explosive devices for the generation of plane and cylindrically converging detonation waves are described. Some particular effects occurring in the experiments, such as the formation of jets, are mentioned. Author (ESRO)

N67-22490# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati.
THE PROPAGATOR FOR DISTURBANCES IN A PLASMA
R. Nozawa (Tokyo Inst. of Tech.) Oct. 1965 36 p refs Sponsored in part by EURATOM
(LGI-65-27) CFSTI: HC$3.00/MF$0.65

The propagation of high-frequency disturbances in an infinite plasma is studied by the method of propagator. The plasma is assumed to be an electron fluid with positive uniform background. The propagator is given explicitly in terms of generalized functions. It possesses a characteristic rear wake behind the head of the wave, which is expected to appear due to the dispersion. Author (ESRO)

N67-22496# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ON THE PARTICLE, MOMENTUM AND HEAT BALANCE OF A MAGNETIZED PLASMA
Bo Lehnert 4 Oct. 1966 102 p refs
(Rept.-66-17) CFSTI: HC $3.00/MF $0.65

Investigations of the particle, momentum and heat balance of a partially ionized plasma are extended, and results applied to rotating and nonrotating fully ionized plasmas which are confined by a poloidal magnetic field and surrounded by boundary regions containing neutral gas. The heat balance of nonrotating high-density plasma is estimated for a partially open-end system subjected to Ohmic heating and magnetic pumping. Some simple methods of measuring the confining properties of a magnetic configuration and of the temperature and its decay are suggested. ESRO

N67-22498# Royal Inst. of Tech., Stockholm (Sweden). Electron and Plasma Physics Div.
SEPARATION OF MATTER AND ANTIMATTER
H. Alfven Dec. 1966 18 p refs
(Rept.-66-18) CFSTI: HC $3.00/MF $0.65

Some processes during the metagalactic development are discussed that could produce a separation into matter and antimatter in a homogeneous ambiplasma supposed to be collision-free. ESRO

N67-22546# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PLASMA DIAGNOSTICS
J. Charles Ingraham and Sanborn C. Brown 3 Oct. 1966 38 p refs
(Contracts DA-36-039-AMC-03200(E); AT(30-1)-1842))
(MIT-1842-36; TR-454; AD-645110) CFSTI: HC $3.00/MF $0.65

The report is designed to provide a practical description of laboratory microwave techniques for studying plasmas, as well as to mention briefly other techniques that can be used in plasma studies. Author (TAB)

N67-22551# Maryland Univ., College Park. Dept. of Physics and Astronomy.
EXPERIMENTAL OBSERVATIONS OF THE STRUCTURE OF SHOCK WAVES IN A COLLISION-FREE PLASMA Final Report, Nov. 1, 1961–Oct. 31, 1966
H. R. Griem and George C. Goldenbaum Nov. 1966 91 p refs
(Contract AF 19(628)-269)
(AFCRL-66-826; AD-645618) CFSTI: HC $3.00/MF $0.65

Contents: The laminar one fluid approach; The laminar two fluid approach; The piston problem; Summary of the laminar approach; Turbulence; Vacuum and gas filling systems; Trigatron spark gap switches; Production of the initial plasma and magnetic field; Generation of the shock wave; Grounding and shielding; Coil voltage measurements; Magnetic field measurements; Emission spectroscopy; Magnetic structure measurements; Electron temperature measurements. TAB

N67-22568# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LECTURES ON PLASMA PHYSICS
K. D. Sinel'nikov and B. N. Rutkevich 2 Jun. 1966 317 p refs Transl. into ENGLISH from Russian
(FTD-TT-65-1565; TT-67-60493; AD-645818) CFSTI: HC $3.00/MF $0.65

Contents: Stellar energy sources and thermonuclear reactions; Effective cross sections and energy balance in thermonuclear reactions; Collisions and relaxation processes; Movement of charged particles in electric and magnetic fields; Confinement of charged particles by magnetic fields; Fundamentals of magnetohydrodynamics; Autopericstic pinch discharge and plasma stability; Dynamic pinch and shock waves; Waves in plasma; Motion of charges in axisymmetric fields-plasma clusters. TAB

N67-22573# ARO, Inc., Arnold Air Force Station, Tenn.
CHARACTERISTIC EQUATIONS FOR A SUPERSONIC FLOW PROBLEM WITH MAGNETOHYDRODYNAMIC EFFECTS
F. C. Loper and M. B. Lightsey Arnold Eng. Develop. Center, Jan. 1967 22 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-206; AD-645107) CFSTI: HC $3.00/MF $0.65

A derivation of the characteristic equations for supersonic inviscid flow with magnetohydrodynamic (MHD) forces present is given for the two-dimensional and axisymmetric cases. Workable forms of the equations relating the MHD effects are indicated for the axisymmetric problem. Author (TAB)

N67-22651*# Massachusetts Inst. of Tech., Cambridge.
PHYSICAL ACOUSTICS
K. U. Ingard, L. W. Dean, III, R. H. Katyl, J. L. Macon, W. M. Manheimer et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 97–112 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract Nonr-1841(42))

Several studies in the emission, propagation, and absorption of acoustic waves in matter are described. The electric field associated with a sound wave in a weakly ionized gas is considered, and it is shown that the thermal motion of the electrons results in an incomplete screening of the electric fields associated with perturbations in ion density, so that the ions are subjected to competing electrical and collisional forces. The dissipative effects in a hydrodynamic plasma are investigated, in which the plasma is treated as if it were a classical viscous fluid and the hydrodynamic equations describing such a fluid are used. In the analysis it is shown that longitudinal and transverse waves propagate independently (with different dispersion relations) in such a plasma. Finally, consideration is given to a study of the interference of light with light in a plasma, in which the perturbation effects of externally produced electromagnetic waves on a homogeneous, collisionless, nonrelativistic plasma are examined. L.E.W.

N67-22664*# Massachusetts Inst. of Tech., Cambridge.
PLASMA PHYSICS
S. C. Brown, W. P. Allis, G. Bekefi, J. J. Ingraham, G. Lampis et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 123–136 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract AT(30-1)-1842)

Continuing development of the far infrared spectrophotometer and study of electron plasma oscillations are reported. The design of the spectrophotometer is described, and details are given on the features of the optical arrangement, most of which are concerned with maximizing the radiant flux through the system. The dispersion relation for the waves and their temporal growth rate in the electron plasma were investigated, and the data are graphed. N.E.N.

N67-22668*# Massachusetts Inst. of Tech., Cambridge.
PLASMAS AND CONTROLLED NUCLEAR FUSION
L. D. Smullin, A. Bers, G. D. Barnard, R. J. Briggs, J. G. Siambis et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 141–169 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Grants NSF GK-57; NSF GK-1166)

Papers are presented on various active plasma systems, applied plasma physics, and plasma magnetohydrodynamic flows, waves, and instabilities. Beam plasmas and plasma slabs, sheet

models, plasma stabilities, and electron interactions are covered. Two types of oscillations in the highly ionized argon plasma produced by the hollow cathode discharge arc were detected and are discussed. A theoretical analysis of an electron beam–plasma interaction with a spatially inhomogeneous temperate plasma is presented. N.E.N.

N67-22657*# Massachusetts Inst. of Tech., Cambridge.
INTERACTION OF LASER RADIATION WITH PLASMAS AND NONADIABATIC MOTION OF PARTICLES IN MAGNETIC FIELDS
D. J. Rose, T. H. Dupree, L. M. Lidsky, S. Yip, T. S. Brown et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 175–179 *refs* (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract AT(30-1)-3285)

Nonadiabatic injection of a cw electron beam into a toroidal magnetic field to produce a circulating electron stream is discussed. The beam was injected into the torus by means of a pulsed electric field, and this resulted in adiabatic motion and many transits. Preliminary probe data is presented, and it was concluded that the long lifetime of the circulating beam meets requirements for perturbation studies and for investigating the closure of drift surfaces in closed B-field systems. N.E.N.

N67-22700# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
HARMONIC GENERATION USING THE VARACTOR CAPABILITIES OF THE PLASMA SHEATH
Roger A. Holmes and Robert T. Hilbish Dec. 1966 152 p refs
(Contract N00016-66-C0076-A04)
(TR-EE66-23; AD-646307) CFSTI: HC $3.00/MF $0.65

A study was made of large signal, high frequency phenomena occurring in a slightly ionized plasma contained within a set of concentric, metallic coaxial cylinders. An rf equivalent circuit is developed wherein the sheath is represented by a voltage dependent capacitor in parallel with a voltage dependent resistor, the pre-sheath by a collisionless loss element, and the plasma region by a series resistor and inductor. It is found that when the sheath is thin compared to the radius of the inner cylinder, the voltage dependance of the sheath capacitor reduces to form identical with that of an abrupt junction varactor diode, so that the plasma capacitor is properly called a plasma varactor. As an application of the plasma varactor, frequency doubling using standard semiconductor varactor techniques is attempted. The resultant peak conversion efficiency is found to be 31.6% at a drive frequency of 142mc and input power of .42w. It is shown that the sheath conductance is responsible for this low conversion efficiency relative to that obtainable from a semiconductor varactor, and it is suggested that the use of a lower temperature discharge plasma, such as cesium, should result in a substantial improvement. Author (TAB)

N67-22760*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TWO PLASMA PROBE TECHNIQUES
D. L. Waidelich *In its* 1966 Session of the Goddard Summer Workshop [1967] p 295–300 *refs* (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

A brief survey was made of the work done on two plasma probe techniques, one of which was the plasma resonance probe. The other probe technique embodies the idea of using the second derivative of the current–voltage characteristic of the Langmuir probe as a means of finding the electron energy distribution function of a plasma. An extensive bibliography accompanies the brief technical history of these two techniques. R.Li.

N67-22761*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSITIVE ION COLLECTION BY SPHERICAL LANGMUIR PROBES
Glenn R. Joyce (Iowa Univ.) and James D. Murphy (Catholic Univ. of Am.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 301–309 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Summarized technical details are reviewed on the positive ion collection by spherical Langmuir probes, and a useful table is cited which lists numerical results from theories developed before 1964. In this analysis, the use of a Maxwellian distribution for particles in the ambient plasma leads to a non-linear integral equation for the electrostatic potential. Because of the difficulty in solving this equation, the assumption of a monoenergetic velocity distribution was often made. With this assumption, the integral equation becomes a differential equation. Reduction of the integral equation by other physically reasonable approximations seemed necessary and an attempt was made to reduce the integral equation to a differential equation by a low temperature assumption. R.Li.

N67-22764*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PLASMA-RESONANCE PROBE
Michael P. Smith *In its* 1966 Session of the Goddard Summer Workshop [1967] p 333–357 *refs* (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

The plasma-resonance probe, a diagnostic device used in determining some of the properties of a plasma environment, is described. It consists of an electrode to which a radio-frequency voltage is applied. The probe is operated by recording the direct current drawn from the plasma by the probe as a function of the radio-frequency applied to the probe, obtaining a typical resonance peak. Mathematical expressions are derived to obtain a value for the electron density, and the electron-neutral particle collision frequency. Also reported are the theory of the resonance probe, and the experimental apparatus and technique used. R.Li.

N67-22765*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NITROGEN PLASMA
John H. Kinnier *In its* 1966 Session of the Goddard Summer Workshop [1967] p 359–372 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

To simulate the space environment encountered by a satellite in terms of temperature, vacuum, and solar flux, a model nitrogen atmosphere was investigated. Parameters pertinent to high altitude charged particle regions are graphed. Technical details are given on beam neutralization, general plasma diagnosis, retarding potential analyser, and the spherical probe. Langmuir probe techniques, used to measure the electron temperature and density of a plasma, are mentioned. The utilization of the resonance probe, a Langmuir probe held at a fixed dc potential in the electron repelling region modulated by an R.F. signal, is also briefly outlined. It was concluded that the electron-bombardment source is capable of producing a steady nitrogen plasma of varying density over a considerable volume. As the plasma spreads out from the source, it becomes more uniform and the plasma potential approaches ground potential. In those circumstances wherein an ion energy somewhat greater than those of the ionosphere is acceptable, a medium is produced which is suitable for the study of the behavior of many objects and devices in a streaming plasma. R.Li.

N67-22768*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PROBE TO MEASURE PLASMA CONDUCTIVITY
D. L. Waidelich, G. R. Joyce, and J. Zurkow *In its* 1966 Session of the Goddard Summer Workshop [1967] p 373–387 *refs* (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

Used primarily for measurements in very dense plasmas and at relatively high radio frequencies, a plasma conductivity probe was developed. Some preliminary experimental results are presented on the possibilities of making measurements with this probe in a low density plasma and at a relative low frequency. A theoretical analysis is given for the change of impedance of the probe when it is measured in a plasma. R.L.

N67-22863*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PLASMA STABILITY AND THE BOHR–VAN LEEUWEN THEOREM
J. Reece Roth Washington, NASA, Apr. 1967 54 p refs
(NASA-TN-D-3880) CFSTI: HC$3.00/MF$0.65 CSCL 20I

The characteristics of collisionless, nonrelativistic, magnetically confined plasmas possessing minimum reservoirs of free energy are examined. The characteristics of the plasma and magnetic field examined, and a set of sufficient conditions for vanishing transverse current is obtained that is consistent with the minimization of free energy within the plasma element. The deduced characteristics of Local Classical Kinetic Equilibrium plasmas with minimum free energy are compared with results reported in the experimental literature. Examples are found in which the observed characteristics conform to those predicted in this report. A conceptual design is presented of a plasma injection and confinement system, which is aimed at maintaining a condition of minimum free energy during and after plasma buildup. The system consists of a bumpy torus confinement geometry together with a suitably modified Penning discharge plasma injection scheme. Experimental results obtained with such a Penning discharge injection scheme are used to show its capabilities for generating an approximately Maxwellian and isotropic plasma within the confinement geometry. Author

N67-22905# International Centre for Theoretical Physics, Trieste (Italy).
VELOCITY SPACE INSTABILITIES IN A TOROIDAL GEOMETRY
H. L. Berk (California Univ., La Jolla) and A. A. Galeev (Inst. for Nucl. Phys.) Nov. 1966 40 p refs Sponsored in part by the AEC
(IC-66-91, Rev.) CFSTI: HC$3.00/MF$0.65

A self-consistent equilibrium is derived for a simple toroidal model from knowledge of the particle orbits. This equilibrium is investigated for velocity space instabilities analogous to the loss cone of mirror machines. An ion instability generated by particles in 'trapped' or nearly 'trapped' orbits is found when the rotational transform is relatively weak, but is stabilized with larger rotational transform. Instability is also found at the plasma edge due to a loss of particles in a preferred region of velocity space. A qualitative discussion on the quasi-linear development of these instabilities is presented. Author (ESRO)

N67-22908 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MAGNETOHYDRODYNAMIC WAVES IN A HELICAL FIELD [FALE MAGNETOHYDRODYNAMICZNE W POLU SKRECONYM]
Eryk Infeld Nov. 1966 13 p refs
(INR-760/VII/PH) CFSTI: HC$3.00/MF$0.65

The effect of a rectilinear current on Alfven waves in a bounded medium is investigated. It transpires that an infinite spectrum of frequencies corresponds to each Alfven frequency obtained without the current. A radial component of the disturbed field will always be present, even though none need be present for the current-free case. This component is a discontinuous function of the current (discontinuous at zero). An experiment aimed at proving that line current in a cylindrical tube containing liquid sodium splits up the eigenfrequencies, is suggested. Author

N67-22920# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
WORK REPORT, 1965 [VERKSAMHETSRAPPORT, 1965]
[1965] 22 p refs In SWEDISH; ENGLISH summary
(Rept.-66-03) CFSTI: HC$3.00/MF$0.65

The research activity has been directed towards: plasma confinement and fusion reactions in the magnetic field of a ring current; study of high pressure discharge and ionizing current wave in coaxial plasma gun; experiments with plasma entering a magnetic dipole field and plasma in an inhomogeneous magnetic field; electric fields in collisionless plasma in a mirror field; study of electric arcs at atmospheric pressure and of double layers in a mercury discharge; theory of circuit interruption in a plasma; development of electron accelerators; cosmic radiation, cosmology, and cosmogony as well as physics of the magnetosphere and ionosphere. ESRO

N67-22937# National Aeronautical Lab., Bangalore (India).
MAGNETOHYDRODYNAMIC TRANSPIRATION COOLING
N. Rudraiah Oct. 1966 19 p refs
(TN-PH-4-66) CFSTI: HC$3.00/MF$0.65

The problem of transpiration cooling between two porous concentric spheres with an electrically conducting viscous incompressible steady fluid as coolant and with different applied magnetic fields in the θ-direction is discussed. It is assumed that the fluid is either ejected through the porous walls into the main flow or is removed from the main flow by suction. The properties of the fluid both in the main flow and in passing through the porous walls are assumed constant and identical. To determine the effect of magnetic field on the temperature and pressure, the flow equations were made dimensionless and the solutions expressed in terms of the dimensionless parameters, Hartmann number, Reynolds number, Eckert number, Pecklet number and Stuarts number. The temperature and pressure distributions are obtained. It was found that the magnetic field has considerable effect on the pressure coefficient, temperature and heat transfer coefficients. Author

N67-22943# Nagoya Univ. (Japan). Research Information Center.
COMPUTER EXPERIMENTS WITH CHARGED PARTICLES, CHARGED FLUIDS AND PLASMAS: A CLASSIFICATION AND BIBLIOGRAPHY
Charles K. Birdsall Dec. 1966 29 p refs
(IPPJ-54) CFSTI: HC$3.00/MF$0.65

An attempt was made to list and classify some papers dealing with results in computer experiments with charged particles, charged fluids, and plasmas. The references are listed by applications, charged particle model, and charged fluid model. Definitions related to computer experiments are given. Finally a chronological bibliography is included, which applies primarily to the motion of charged particles and charged fluids both in self and applied electric and magnetic fields. L.E.W.

N67-22947 Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART 3. ARCS IN TRANSVERSE MAGNETIC FIELDS AT ATMOSPHERIC PRESSURE
V. W. Adams Dec. 1965 81 p refs
(RAE-TR-65273, Pt. 3) CFSTI: $3.00

Experimental results in air at a pressure of one atmosphere on the behavior of arcs under the action of applied magnetic fields are given for two electrode materials (graphite and brass) and different electrode configurations. These results extend earlier work to larger electrode path lengths on graphite and brass, and also include results for a pair of long straight electrodes. The range of arc current has been extended to 3700 amps and the applied magnetic field to 0.49 Wb/m^2 for experiments on a pair

of straight electrodes. The results are analyzed using a simple model for the arc motion assuming that the arc behaves in the same way as a body in a gas stream. Some comments are made on a major difference between results for brass and graphite electrodes in experiments where the arc wake might affect the arc motion. Arc drag areas are calculated for results where the arc wake does not affect the motion and are found to be about one half of the maximum luminous frontal areas of the arc determined photographically. Finally the results are analyzed according to a theory for convection-stabilized arc columns and smoothed-out results for arcs moving through stationary air at constant temperature are shown to agree qualitatively with this theory. Author

N67-22983# Nagoya Univ. (Japan). Research Information Center.
PLASMA COMPUTER EXPERIMENTS IN THREE DIMENSIONS: DEVELOPMENT OF A CODE FOR GUIDING CENTER FLUIDS
Charles K. Birdsall and Tetsuo Kamimura (Osaka Univ.) Dec. 1966 51 p Refs Sponsored by NSF
(IPPJ-55) CFSTI: HC $3.00/MF $0.65

An outline is presented of a simple computer experiments code that can accept mirror plus Ioffe bar fields and follow the motion of a neutral or nearly neutral two-fluid plasma at low frequencies. The calculation is basically Eulerian, with densities, velocities, and potentials known only at the three dimensional grid points. The object of the experiments is to find the final state of known instabilities when excited initially, singly, or multiply at small amplitudes. C.T.C.

N67-22984# Nagoya Univ. (Japan). Research Information Center.
PARTICLE ASPECT ANALYSES OF ELECTROMAGNETIC AND ELECTROSTATIC INSTABILITIES DUE TO ANISOTROPIC VELOCITY DISTRIBUTIONS
Y. Terashima Dec. 1966 36 p Refs
(IPPJ-56) CFSTI: HC $3.00/MF $0.65

The physical mechanisms of electromagnetic and electrostatic instabilities due to anisotropic velocity distributions are studied from the particle point of view. Two examples are worked out in detail; the unstable cyclotron waves of electromagnetic mode which propagate along a static magnetic field and the unstable electrostatic waves of oblique propagation. The present analyses are based on a physical model similar to that used by Dawson in his theory of Landau damping. The plasma particles are divided into nonresonant particles and resonant ones. It is assumed that initially the main plasma of nonresonant particles has a wave under discussion on it while resonant particles are undisturbed. Resonant particles are supposed to have some limited value of the velocities along the magnetic field in order to see the Doppler-shifted frequency of the wave nearly equal to the gyration frequency or its harmonics. The change in energy of resonant particles is computed by following their trajectories within the framework of linear theory. Instability criteria are derived from the rate of energy transfer between wave and particles. Author

N67-22986# Institut fur Plasmaphysik G.m.b.H. Garching (West Germany).
EXPERIMENTAL INVESTIGATIONS OF A HYDROGEN ARC IN AN AXIAL MAGNETIC FIELD [EXPERIMENTELLE UNTERSUCHUNGEN AN EINEM WASSERSTOFF-LICHTBOGEN IM ACHSENPARALLELEN MAGNETFELD]
C. Mahn, H. Ringler, and G. Zankl Nov. 1966 44 p Refs in GERMAN; ENGLISH summary
(IPP-3/44) CFSTI: HC $3.00/MF $0.65

In a stationary dc arc, the electric power input is balanced essentially by heat conduction losses in the radial direction. These losses increase greatly with temperature and thus they limit the axial temperatures attainable with reasonable power input. An experiment is described in which considerably higher plasma temperatures have been obtained by reducing the coefficient of heat conduction with a superimposed axial magnetic field. At arc currents of about 2 kA and a magnetic field of 10 kG temperatures in the middle of the arc of 10 eV were reached. The measured temperature, pressure, and velocity of the hydrogen plasma are compared with calculated values. In particular, the coefficient of heat conduction perpendicular to a magnetic field has been determined by measuring the radial temperature profile and the electric field strength. The results agree with theoretical predictions. Author

N67-22988# Institut fur Plasmaphysik G.m.b.H. Garching (West Germany).
EXPERIMENT STUDYING THE INTERACTION OF SHOCK WAVES WITH STATIONARY MAGNETIC FIELDS [EXPERIMENTE ZUR UNTERSUCHUNG VON WECHSELWIRKUNGEN ZWISCHEN STOSSWELLEN UND STATIONAEREN MAGNETFELDERN]
H. Klingenberg and H. Muntenbruch Nov. 1966 32 p Refs in GERMAN; ENGLISH summary
(IPP-3/45) CFSTI: HC $3.00/MF $0.65

The simple conditions necessary are provided by a diaphragm shock tube and a stationary magnetic field, and also by electrodes placed flat against the inside walls of the tube and connected outside the tube. In the preliminary experiments the currents produced on interaction in shock-heated argon plasma are measured as a function of time for varying initial pressure (and hence flow velocity and conductivity), electrode surface area, magnetic field, and load resistance. The maximum short-circuit current is several kA for magnetic fields of a few kG. The time resolution makes it possible (allowing for the inductance of the discharge circuit) to compare the current with the conductivity of the plasma (which depends on relaxation) as a function of time. Author

N67-23009 RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
FOCUSSED MICROWAVE SYSTEMS FOR PLASMA DIAGNOSTICS. II: INTERACTION WITH DIELECTRIC MEDIA
C. Richard and A. I. Carswell Apr. 1966 107 p refs
(Contract PD69-500000)
(RCA Res. Rept.-7-801-46) CFSTI: $3.00

In this report, the importance of phenomena such as diffraction, reflection, and refraction taking place in the interaction of a focussed microwave beam with a dielectric is investigated experimentally. Transmission measurements are conducted on various materials with dielectric coefficients between 1.03 and 2.6 for three different geometries (slab, wedge, cylinder). Geometrical optics models of the interactions are constructed and their predictions are compared with the experimental results. Refraction effects are found to be the most important source of errors. Phase ambiguities as well as additional complications introduced by off-focus position of the cylindrical dielectric are studied. All results are critically discussed in terms of their implications on the limitations of the focussed beam system for plasma diagnostics. Author

N67-23059# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE FLAT-PLATE MAGNETOHYDRODYNAMIC BOUNDARY LAYER IN A TRANSVERSE MAGNETIC FIELD
John K. Dukowicz Jan. 1967 31 p refs
(Grant AF-AFOSR-366-66)
(UTIAS-88; AFOSR-67-0004; AD-646773) CFSTI: HC $3.00/MF $0.65

The equations of motion for a flat plate boundary layer flow of an incompressible, electrically conducting fluid in the presence

of a transverse magnetic field moving with the main stream velocity were solved numerically for the case of negligible induced magnetic field. The equations of motion were transformed into a universal form with no characteristic parameters present. The velocity profiles were calculated as they range from the Blasius profile to the asymptotic exponential profile. The error due to the finite-difference solution was also calculated. Author (TAB)

N67-23078# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
MEASUREMENTS OF THE DIFFUSION RATE OF A WEAKLY IONIZED PLASMA TRANSVERSE TO A MAGNETIC FIELD
K. H. Geissler Aug. 1966 21 p refs
(IPP-2/50) CFSTI: HC $3.00/MF $0.65

The decay times of a weakly ionized afterglow plasma were measured as a function of the magnetic field and neutral gas pressure. The magnetic field was varied from 214 to 2500 gauss. The neutral pressure was varied from 3×10^{-2} to 8.5×10^{-2} torr. The working gas was helium. The plasma, which had mean densities between 10^8 and 5×10^9 cm^{-3}, was confined by a glass tube 70 cm in length and with an inner diameter of 5.15 cm. It was found that the coefficient of the plasma diffusion perpendicular to the magnetic field may be written as a sum of two contributions, one being of the classical type and the other of the Bohm type. Author

N67-23120# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
GASDYNAMIC METHODS IN MAGNETOHYDRODYNAMICS Final Report, 1 Jan. 1963–31 Dec. 1966
F. Cap 31 Dec. 1966 108 p refs
(Contract AF 61(052)-675)
(AFOSR-67-0151; AD-645632) CFSTI: HC $3.00/MF $0.65

In order to investigate the applicability and extension of gasdynamic methods for MHD flow, the generalisation of the Crocco theorem for plasmas and the conditions for potential flow in a plasma with infinite electrical conductivity were derived. Next two-dimensional steady and one-dimensional unsteady potential flows were investigated by the graphical characteristics and by variational methods. Then two-dimensional steady and one-dimensional unsteady problems for a plasma with finite electrical conductivity were solved and the new methods were applied to a travelling wave plasma accelerator, to crossed-field accelerators and to magnetic nozzles. It was shown that the new methods can be applied also to Hall propulsion devices to MHD generators and to viscid plasma flows with non-vanishing heat conductivity and with varying electric conductivity. Author (TAB)

N67-23142# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE FLOW OF STRONGLY RAREFIED PLASMA AROUND A CHARGED BODY
N. T. Peshchenko 7 Nov. 1966 15 p refs Transl. into ENGLISH from Arch. Mech. Stosowanej. (Poland), v. 16, no. 2, 1964 p 521–528
(FTD-HT-66-290; TT-67-60677; AD-646276) CFSTI: HC $3.00/MF $0.65

The problem of a strongly rarified plasma flow around a charged body was investigated by many authors with a majority of investigations devoted to plasma oscillations. In this case the body is considered as a point, and boundary condition problems were studied. Jastrow and Pears assumed a potential field around the body as a spherical symmetrical and found a solution analogous to the Debye solution, but the assumption adopted by them did not actually consider the bodys oncoming. In the report a case is discussed in which the Debye radius is large in comparison to the characteristic dimension of the body, which is not applicable during the investigation of body movements in the ionosphere, where a reversible relation takes place. The reports used in solving the equation for the potential of iteration methods did not give the possibility of detecting the characteristic phenomenon of the boundary layer which gives a rapid change in potential in the vicinity of the body and the given expressions for the potential are valid only at a great distance from the body. In addition, errors in determining the ion density were committed which involved errors in determining the potential. Author (TAB)

N67-23177# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
PARAMETRIC COUPLING BETWEEN TRANSVERSE ELECTROMAGNETIC AND LONGITUDINAL ELECTRON WAVES Scientific Report
A. Sjoelund and L. Stenflo 30 Oct. 1966 16 p refs
(Contract AF 61(052)-895)
(SR-9; RADC-TR-67-33; AD-645745) CFSTI: HC $3.00/MF $0.65

Parametric coupling between transverse electromagnetic and electron waves in a plasma was studied by means of coupled mode theory. The coupling coefficients was determined. Two examples of parametric coupling were considered. One is the same as treated by Montgomery, and the other results in parametric amplification. The growth rate was calculated. Author (TAB)

N67-23189# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
RESULTS OBTAINED FROM THE "BILLE EN TETE A" EXPERIMENT [RESULTATS EXPERIMENTAUX SUR BILLE EN TETE "A"]
Paul Evrard, Jean Jacquinot, Christian Leloup, Jean-Pierre Poffe, and Francois Waelbroeck 1966 62 p refs In FRENCH
(CEA-R-3000; EUR-2792.f)

Collisions of plasma puffs, whose characteristics (density and velocity) were varied in a broad domain are studied in a homogeneous longitudinal magnetic field. It has been verified that the puffs meet head on. It is shown that collisions of dense ($n_0 \geq 4.10^{14}$ cm^{-3}) and relatively slow ($v_0 \leq 10^7$ cm.s) puffs are "efficient," i.e., the initial kinetic energies of the puffs are converted into thermal energy of the ions in the resulting plasma. Faster and less-dense puffs interact little:incomplete conversion of kinetic into thermal energy. The limit between efficient and inefficient collisions corresponds to that which is expected from the test particle model. The slowing down of the puffs is thus ensured mainly by particle–particle interactions. The use of electric probes and the examination of the evolution of the plasma produced by the collision show that this plasma does not exhibit any rapid radial motion. In the magnetic bottle of Bille-en-Tete A (mirror ratio 4000/2000 G), the collision of two low-density puffs leads to the capture of one liter of plasma with a density $n_i \simeq 2.10^{13}$ cm^{-3} and an ionic temperature $T_i \simeq 10^6$ °K. The e-folding time of the plasma diamagnetism reaches 50 to 150 μs; no flute instabilities are detected. The T_i evolution was measured by the Doppler broadening of the 4686 Å line of the He^+ (added to the injected D^+ in the proportion of 5 per cent and the relative evolution of n_i by the intensity of the spectral continuum. T_i decreases rapidly, reaches 5.10^5 to 10^5 °K, respectively, 15 and 120 μs after the maximum of the collision diamagnetic signal; n_i increases slowly, 25% during the first 100 μs after the collision. The presence of cold plasma beyond the mirrors of the bottle allows one to justify the energy losses (thermal conductivity) and the apparent stability of the plasma column. Author (NSA)

N67-23222# Los Alamos Scientific Lab., N. Mex.
LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Annual Status Report for Period Ending 31 Oct. 1966
Nov. 1966 147 p refs
(Contract W-7405-ENG-36)
(LA-3628) CFSTI: HC $3.00/MF $0.65

Engineering developments are discussed for the Scylla III, Scylla IV, Scyllac, and Scyllacita devices. The plasma properties in each of these devices are briefly described. Research toward application of holography to plasma diagnostics is discussed. Research on the caulked stuffed cusp experiment is outlined. The plasma gun research developments are discussed. In particular, the Mushroom experiments are described. The activities of the theoretical plasma group are summarized. NSA

N67-23223# Stanford Univ., Calif. Inst. for Plasma Research.
STEADY-STATE THEORY OF A LOW-PRESSURE DISCHARGE COLUMN IN AN AXIAL MAGNETIC FIELD
S. A. Self Oct. 1966 30 p refs
(Contract AT(04-3)-326)
(TID-23490; SUIPR-TR-104) CFSTI: HC $3.00/MF $0.65

A steady-state theory of a low-pressure discharge column in a magnetic field is derived in terms of the moments of the Boltzmann equation. For the electrons, the first two moment equations are used with a scalar pressure. For the ions the first three moment equations are used with an adiabatic assumption. Numerical solutions are given for the profiles of velocity, potential, density, and ion stress tensor for both planar and cylindrical geometry for ranges of the parameters of practical interest. A discussion is given of the application of the theory to experimental situations. Author (NSA)

N67-23227# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
EXPERIMENTAL INVESTIGATIONS OF THE CURRENT DENSITY DISTRIBUTION IN A MAGNETOHYDRODYNAMIC GENERATOR WITH SEGMENTED ELECTRODES [EXPERIMENTELLE UNTERSUCHUNGEN DER STROMDICHTEVERTEILUNG IN EINEM MAGNETOHYDRODYNAMISCHEN GENERATOR MIT SEGMENTIERTEN ELEKTRODEN]
Fred W. Fischer Jul. 1966 51 p refs In GERMAN; ENGLISH summary
(IPP-3/41)

In a magnetohydrodynamic generator with segmented electrodes the current distribution is inhomogeneous due to the existence of the Hall effect. This is particularly true in the immediate vicinity of the electrodes. Calculations of the current density distributions in a generator whose working fluid is a rare gas–alkali metal plasma were based on a theory with many simplifying assumptions. The results of these calculations were compared with measurements on an argon–potassium generator. The temperature of the working gas was approximately 2000°K, and the flow velocity was 130 m/sec max. at a pressure of 1.1 atm. For the purpose of seeding, 0.22% (by weight) potassium was added to the argon. The magnetic field was 4.5 kG max. Conclusions could be drawn on the distribution of electron temperature, and thus on current density, from the spatial intensity distribution of the potassium resonance lines. In general, qualitative agreement was found with the theoretically determined distribution. Near the electrodes, especially along the insulating wall between two electrodes, considerable differences from theoretical values were noticed. Measurements of the electrical potential along the insulating wall confirmed these latter observations. Author (NSA)

N67-23228# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
EQUILIBRIUM AND STABILITY OF A PLASMA WITH SURFACE CURRENT [GLEICHGEWICHT UND STABILITAET EINES PLASMAS MIT OBERFLAECHENSTROEMEN]
Horst Wobig Jul. 1966 54 p refs In GERMAN; ENGLISH summary
(IPP-6/53)

The equilibrium and stability of toroidal plasma configurations which were found by F. Meyer and H. U. Schmidt [Zeit. fur Naturf. 13a, 1005(1958)]. These so-called M and S surfaces are characterized by a vanishing total azimuthal current ($I_{az} = 0$). Starting point is the model of a fieldless plasma with surface currents. From the equilibrium condition $B^2 = 8\pi p$ we obtain a differential equation for the surface S. $\sum_{ik} (\partial\phi/\partial x^i)(\partial\phi/\partial x^k) = 1$ (g_{ik} = metric tensor of S; ϕ: $\vec{B} = \Delta\phi$ on S; p = plasma pressure; x^i (i = 1, 2)$_1$ = surface parameter). The surface S is described by its distance $r(x^1, x^2)$ to a closed reference line. If $\phi(x^1, x^2)$ is given, the equation above yields a differential equation for $r(x^1, x^2)$. $g_{ik} = g_{ik}[r_1(\partial r/\partial x^1), (\partial r/\partial x^2)]$. It is shown how to obtain approximately a solution of this equation. The stability is investigated using the energy principle of magnetohydrodynamics. It is shown, that the equilibrium surfaces calculated by Meyer and Schmidt are unstable against pure interchange perturbations ($\delta\vec{B} = 0$). Furthermore a stability criterion for interchange disturbances is given. In the limit of a vanishing aspect ratio (linear bumpy ϑ-pinch) we also consider perturbations which change the magnetic field ($\delta\vec{B} \neq 0$). Instability for perturbations with constant amplitude along the magnetic field lines is obtained. The growth rates are estimated. Author (NSA)

N67-23232# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE INTERNAL RESISTANCE OF MHD GENERATORS [ANALYTISCHE UNTERSUCHUNG DES INNENWIDERSTANDES VON MHD GENERATOREN]
L. L. Lengyel Jun. 1966 32 p refs In GERMAN
(IPP-3/39) CFSTI: HC $3.00/MF $0.65

The internal resistance of MHD generators as a function of the electrode geometry and the Hall parameter is considered herein. The perturbation of the current and potential distributions by the Hall parameter and the effect of a staggered-electrode geometry upon the internal resistance are studied in detail. It has been found that changes in the internal resistance for equal positive and negative staggering angles are identical. Author (NSA)

N67-23272*# Pennsylvania Univ., Philadelphia.
FIRST ORDER EFFECTS OF PRODUCTION ON THE CONTINUUM THEORY OF SPHERICAL ELECTROSTATIC PROBES
Ira M. Cohen and S. Schweitzer Feb. 1967 44 p refs
(Grant NsG-316)
(NASA-CR-83545; INDEC-47) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The analysis of spherical Langmuir probes, immersed in an infinite, homogeneous, slightly ionized, collision-dominated plasma, is given to first order in the smallness of a parameter characterizing the effects of ionization and recombination. The treatment is given as a double limit: mean free path << sheath thickness << probe radius and the weakness of production effects. The governing diffusion equations are solved to the lowest order in $\rho_p = r_p/\lambda_D$ and to first order in the smallness of the production parameter. Current–voltage characteristics are computed from integrals of the solutions and emphasis is placed on their interpretation with respect to measurements. The first order effects of ionization and recombination are also discussed. Author

N67-23391# International Centre for Theoretical Physics, Trieste (Italy).
INFLUENCE OF STATIC, RADIAL ELECTRIC FIELDS ON TRAPPED PARTICLE INSTABILITIES IN TOROIDAL SYSTEMS
A. A. Galeev, R. Z. Sagdeev, and H. V. Wong Aug. 1966 15 p refs Submitted for publication
(IC/66/100) CFSTI: HC $3.00/MF $0.65

The drift motion of trapped particles in toroidal systems leads to a new branch of the gravitational instability. This is stabilized by radial electric fields, and a new unstable mode appears, which is similar to that due to ion impurity density gradients. Author (ESRO)

N67-23392# International Centre for Theoretical Physics, Trieste (Italy).
PLASMA WAVE REFLECTION IN SLOWLY VARYING MEDIA
H. L. Berk, C. W. Horton, M. N. Rosenbluth, and N. R. Sudan Jul. 1966 32 p refs
(IC/66/33) CFSTI: HC$3.00/MF$0.65

A formalism is presented for wave reflection of a slowly varying spatially inhomogeneous thermal plasma described by the Vlasov equation. The formalism generalizes a method originated by Bremmer for differential wave equations. A numerical example shows that the intrinsic thermal properties of the plasma can supply reflection mechanisms that compete with the reflection coefficient predicted for a simple inhomogeneous fluid. Author (ESRO)

N67-23394# International Centre for Theoretical Physics, Trieste (Italy).
ON THE QUASI-LINEAR LIMIT OF A DRIFT INSTABILITY AND ITS RELATION TO AURORAL BOMBARDMENT
N. A. Krall Sep. 1966 15 p refs Submitted for publication
(IC/66/103) CFSTI: HC$3.00/MF$0.65

A drift-wave having quasi-linear behavior is described that is related to auroral bombardment by particles from the radiation belts. The unstable mode discussed here is a drift-wave driven by gradients in the magnetic field and the particle density. ESRO

N67-23398# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
SPACE-CHARGE EFFECTS BY NON-THERMAL IONS IN A MAGNETIZED PLASMA
Bo Lehnert 14 Jan. 1967 36 p refs
(Rept.-67-01) CFSTI: HC$3.00/MF$0.65

Space charge effects are discussed that arise from the finite Larmor radius in combination with transverse density gradients in a magnetized plasma. An example is given where a strongly oscillating potential, having a sheath-like structure and large amplitudes, arise from nonthermal ions with a distribution peaked at a singular velocity. Whenever nonthermal effects of this kind occur, they should introduce fundamental changes in the plasma behavior that cannot be described by elementary plasma theory. Possible applications are given by the motion of a plasma through a neutral gas, where groups of nonthermal effects have an influence on the ionization process and become connected with the mechanisms of ionizing waves and with the observed voltage limitation in rotating plasmas and certain types of plasma guns. Author (ESRO)

N67-23478# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
THE ENERGY TRANSFER MECHANISM IN SHOCK TUBE ARC-HEATED DRIVERS
G. J. Mullaney and H. G. Ahlstrom Nov. 1966 22 p *Its* Flight Sci. Lab. Rept.-111
(D1-82-0582)

It has been found in shock tube arc-heated drivers that radiation transport of energy is the primary mechanism for heating the helium driver gas. The phenomena occurring in the shock-heated driver is as follows. The energy input begins with the vaporization of a small diameter copper wire mounted on the axis of symmetry and continues as the copper vapor propagates out into the helium. A central arc is formed in the copper vapor and a helium–copper mixture moves outward behind the shock wave. The arc which directly heats the copper is localized to about 3 cm radius. The copper arc transfers energy to the copper in the outward moving helium–copper mixture by radiation. A copper atom either is raised to an excited state or ionized and the energy is transferred to the helium by collisions. Because of the high density of the helium the transfer of energy from ions and excited copper to the helium by collisions appears reasonable; the lifetimes of excited states are 0 (10^3 collisions). This model for the energy transfer was developed from experiments with an apparatus designed to produce typical conditions obtained in arc heated drivers. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-22132# California Univ., Livermore. Lawrence Radiation Lab.
THERMODYNAMIC PROPERTIES OF MATTER
In its Phys. Dept. Progr. Rept. Jan. 1966 p 19–36 refs (See N67-22130 11-24) CFSTI: HC$3.00/MF$0.65

Brief summaries of research progress are presented for the following: profile of shock waves in solids, asymptotic expansion of operator sums over a large number of quantum states, phase change for a hard-square lattice gas, equation of state of I, Hugoniot equation of state of Mg alloy AZ31B, shock induced demagnetism, shock-induced solid–solid phase transformation in Bi, and Brillouin scattering behind shock fronts. NSA

N67-22163*# Pennsylvania Univ., Philadelphia.
EXPERIMENTAL DETERMINATION OF THE THERMOELECTRIC PROPERTIES OF GRAPHITE ALLOYS
S. R. Pollack and J. J. Curry *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 2 p (See N67-22161 11-03) CFSTI: HC$3.00/MF$0.65

The completion of the apparatus for the measurement of the thermoelectric power, electrical conductivity, Hall coefficient, and magnetoresistivity is reported, and initial data with semiconductor compounds are presented. Compounds of $CuCd_2InTe_4$ were prepared from commercially pure elements and high purity elements. The thermoelectric power was +340 $\mu V/^\circ K$ at 300°K for the compound made from the commercially pure elements, and the electrical conductivity was 10^{-2} to 10^{-4} $(ohm\text{-}cm)^{-1}$. For the compound prepared from the high purity elements, the thermoelectric power was +85 $\mu V/^\circ K$ and the conductivity was 2.38 $(ohm\text{-}cm)^{-1}$. It is believed that the high thermoelectric power is due to an impurity effect. N.E.N.

N67-22167*# Pennsylvania Univ., Philadelphia.
ANISTROPY OF METAL WORK FUNCTIONS
M. Kaplit *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 11 p refs (See N67-22161 11-03) CFSTI: HC$3.00/MF$0.65

The results of an investigation of the electronic work function differences between four planes of tungsten for both zero and extremely high electric fields are reported. Thermionic and field emission probe tube techniques were used, and representative work functions for single crystal planes are tabulated. Graphs are included for the change in work function with applied electric field strength for field emission and field desorption electric fields, and for the polarizability of surface atoms. The stress due to a field desorption electric field is also shown. N.E.N.

N67-22302# Los Alamos Scientific Lab., N. Mex.
TABLES FOR THE RAPID EVALUATION OF THE DEBYE CHARACTERISTIC TEMPERATURE OF CUBIC CRYSTALS FROM ELASTIC CONSTANTS

W. C. Overton, Jr. and A. F. Schuch 7 Dec. 1966 58 p refs
(Contract W-7405-ENG-36)
(LA-3615-MS) CFSTI: HC $3.00/MF $0.65

Extensive numerical calculations have been carried out on the CDC 6600 computer to obtain accurate tables of a function $G(S,\tau)$. From these tables the Debye characteristic temperature θ of any cubic crystal can be calculated rapidly and with great accuracy. If the cubic crystal elastic constants are known then the parameters $S=(c_{11}-c_{44})/(c_{12}+c_{44})$ and $\tau=(c_{12}+c_{44})/c_{44}$ can be evaluated. The tables range from $S=0.04$ to 4.51 (interval 0.03) and $\tau=1.00$ to 4.80 (interval 0.05), which will span (S,τ) for practically all cubic crystals for which c_{ij}'s are known. All table entries are accurate to ±1 in the sixth decimal. It is possible to compute θ with an absolute accuracy of better than ±1 in 10^5 by two-dimensional interpolation. Usually, linear two-dimensional interpolation gives this accuracy. Any error in θ is essentially determined by the error in the input data, the elastic constants themselves. The boundary corresponding to the vanishing of the cubic shear elastic constant $(c_{11}-c_{12})/2$ is approximately delineated by the tables. The function $(G(S,\tau)$ is equivalent to the cube root of de Launay's tabulated function $f(s,t)$, where $\tau=t+2$; thus these tables are more convenient to use than his. Comparisons of the θ's at 0°K of eight different cubic crystals are made with those computed by other authors who used different methods of numerical integration. All results are found to agree within a few parts in a thousand. Author (NSA)

N67-22316# California Univ., Livermore. Lawrence Radiation Lab.
PHOTOEMISSION INVESTIGATION OF THE BAND STRUCTURE OF FERROMAGNETIC Ni–Al ALLOYS
Walter Michael Breen (Ph.D. Thesis) 15 Oct. 1966 76 p refs
(Contract W-7405-ENG-48)
(UCRL-50118) CFSTI: HC $3.00/MF $0.65

Photoemission measurements that probe the electronic band structure of ferromagnetic Ni–Al alloys have been made by using ultraviolet light from 4.5 to 11.4 eV to determine the excitation density of electronic quantum states down to about 6 eV below the Fermi level. Photoemission data were taken at room temperature on three Ni–Al alloys of compositions 89.6, 92.0, and 95.4 atomic percent Ni. The results are interpreted in terms of both the rigid band model and scattering phenomena. The optical density of states determined to within 25% is the same for all the Ni–Al alloys investigated. Only the position of the Fermi level changes as Al is added, in agreement with the rigid band model. Alloys of higher Al content were not investigated due to complications caused by a structural phase change. Results obtained from a pure Ni sample cleaned by argon bombardment and heat treatment are compared with those from a pure Ni sample formed by evaporation onto a substrate. The photoemission data from both samples are in complete agreement. Since the ferromagnetic intra-atomic exchange splitting in Ni is about 0.6 eV, a search for magnetic effects was made by taking data above the Curie temperature of the 89.6% Ni alloy. A predicted change due to magnetism is discussed in terms of the rigid band model; however, comparison of photoemission data above the Curie point with data below it shows no change due to magnetic effects. Author (NSA)

N67-22480# Pennsylvania Univ., Philadelphia. Dept. of Physics.
SPIN DEVIATION PROBABILITIES IN ORDERED MAGNETIC MATERIALS
Herbert Callen Nov. 1966 6 p refs Submitted for publication
(Contract Nonr-551(36))
(TR-31; AD-644076) CFSTI: HC $3.00/MF $0.65

It is shown that the probability distribution for spin deviations is exponential in many models of magnetic materials. Author (TAB)

N67-22473*# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
A NEW EFFECT IN THE LOW MAGNETIC FIELD ULTRASONIC ATTENUATION OF IMPURE SUPERCONDUCTING NIOBIUM
M. Gottlieb and C. K. Jones 10 Nov. 1966 10 p refs Supported in Part by NASA *Its* Sci. Paper No. 66-9J0-Phony-P2
(NASA-TM-X-63423) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Changes have been found in the ultrasonic attenuation of superconducting niobium at magnetic fields less than 20% of H_{c1}. An interpretation is made based upon the effects of low critical field impurity phases. Author

N67-22547# Republic Aviation Corp., Farmingdale, N. Y.
DISLOCATION BARRIER INTERACTIONS IN CUBIC CRYSTALS. VOLUME II: EXTENDED DISLOCATION BARRIERS ON (112) PLANES IN ANISOTROPIC BODY-CENTERED CUBIC CRYSTALS. STUDY OF THE THEORY OF FRACTURE PHENOMENA Technical Report, 5 Jan. 1965–3 Jan. 1966
L. J. Teutonico Jan. 1967 61 p refs
(Contract AF 29(601)-6691)
(FHR-1699-3; AFWL-TR-66-27, Vol. II; AD-645070)

Two glissile extended dislocations on intersecting (112) planes in a body-centered cubic crystal can interact to form various stair-rod configurations. The stability of these configurations has been determined on the basis of anisotropic elasticity theory for each of ten bcc elements. The widths of the possible extended barriers in each element, as well as the widths of the glissile extended dislocations which are reacting to form the barriers, have been computed in terms of the stacking fault energy of the element. Author (TAB)

N67-22643*# Massachusetts Inst. of Tech., Cambridge.
MICROWAVE SPECTROSCOPY
M. W. P. Strandberg, R. L. Kyhl, T. E. McEnally, Jr., M. U. Palma, Maria B. Palma-Vittorelli et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 15–26 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Research conducted in the study of metals and dielectric crystals by means of uhf and microwave frequency experiments with the use of electromagnetic and acoustic radiation is reviewed. Investigation of the electric field effects in the nuclear magnetic resonance of fluids is summarized. A method, consisting of a least-squares fit of a finite sum of basis functions of the proper symmetry, was developed for expressing the branches of the secular equation for the velocity of sound in an elastic medium. The secular equation was solved for all points on a grid covering a fundamental symmetry region. Finally, ruby cross relaxation is considered, and the nonexponential behavior of electron cross relaxation in dilute ruby was explained in terms of thermal contact between the Cr^{3+} electron dipole–dipole reservoir and the larger Al^{27} nuclear Zeeman reservoir of the Al_2O_3. An electron and nuclear spin-coupling scheme in dilute ruby is illustrated. L.E.W.

N67-22648*# Massachusetts Inst. of Tech., Cambridge.
OPTICAL AND INFRARED SPECTROSCOPY
C. H. Perry, Jeanne H. Fertel, D. J. Muehlner, J. F. Parrish, and N. Tornberg *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 51–59 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contracts DA-36-039-AMC-03200(E); AF 19(628)-6066)

Work carried out in the study of the optical properties of solids determined by both infrared and Raman spectroscopy is summarized, including interferometric spectroscopy and lattice vibrations. Details are given on experiments conducted to ascertain the temperature dependence of the Raman spectrum of $KTaO_3$ and $SrTiO_3$. L.E.W.

N67-22647*# Massachusetts Inst. of Tech., Cambridge.
ULTRASONIC PROPERTIES OF SOLIDS
C. W. Garland, D. B. Novotny, P. E. Mueller, N. E. Schumaker, D. D. Snyder et al. *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 61–62 refs (See N67-22641 11-34)
CFSTI: HC $3.00/MF $0.65
(Contract DA-36-039-AMC-03200(E))

Research conducted in the ultrasonic properties of solids to obtain information about bulk systems near phase transitions or critical points is summarized and plans for future study are outlined. Although the majority of the work is concerned with order–disorder lambda transitions in solids, other systems, e.g., a fluid near its critical point, are also considered. L.E.W.

N67-22650*# Massachusetts Inst. of Tech., Cambridge.
PHYSICAL ELECTRONICS AND SURFACE PHYSICS
R. E. Stickney, M. L. Shaw, F. W. Eberle, D. L. Fehrs, J. W. Gadzuk et al. *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 81–95 refs (See N67-22641 11-34)
CFSTI: HC $3.00/MF $0.65
(Grant NGR-22-009-091; Contract DA-36-039-AMC-03200(E))

Investigation of the interaction of electrons, ions, atoms, molecules, and electromagnetic radiation with solid surfaces is reported, and summary remarks are made on studies of adsorption of gases and vapors on solid surfaces, catalysis and oxidation, scattering of gas atoms and molecules from solid surfaces, and photoinduced surface properties. Details are given on the development of an experimental apparatus for measuring the change in contact potential resulting from the adsorption of various chemical elements on metallic surfaces, and the results obtained for the adsorption of O_2 on Ta are reported. The development of a desorption theory for patchy (e.g., polycrystalline and nonuniform) surfaces is described based on experimental investigation of oxygen desorption from single crystal tungsten. A case of steady state desorption is considered, and the analysis of a simple model is presented. Summaries are also given of research in single-phonon energy transfer between molecular beams and solid surfaces and in the theory of atom–metal interactions. L.E.W.

N67-22680# Sperry Rand Research Center, Sudbury, Mass.
INVESTIGATION OF MAGNETIC INTERACTION MECHANISMS Final Report, 15 Apr. 1965–14 Oct. 1966
John R. Shane, Robert W. Kedzie, Michael Kestigian, Donald H. Lyons, and Franklin F. Y. Wang Nov. 1966 137 p refs
(Contract AF 19(628)-5128)
(SRRC-CR-66-31; AFCRL-66-754; AD-645366) CFSTI: HC $3.00/MF $0.65

The magnetic properties of KMnCl3, RbMnCl3 and CsMnCl3 have been investigated. The Neel points and exchange constants have been determined from magnetic susceptibility measurements. In KMnCl3 and CsMnCl3 the spin configurations are canted, producing weak ferromagnetism. Paramagnetic and antiferromagnetic resonance studies were performed, and the spectra have been interpreted in terms of two-sublattice models. From susceptibility measurements performed on NaMnF3, KCoCl3, KCuCl3, RbCoF3 and RbFeF3, it was found that these compounds have a canted antiferromagnetic configuration at low temperatures. The ordering temperatures and exchange constants have been determined. Antiferromagnetic resonance studies in NaMnF3 have been interpreted in terms of a two-sublattice model containing canting interactions due to both single-ion anisotropy and antisymmetric exchange. The effects of the canting mechanisms have been described and the internal fields used in the model have been determined from the resonance data. It was found that the antisymmetric exchange interaction is at least an order of magnitude larger than the single-ion canting mechanism. The results of the model are in good agreement with the experimental angular dependence of the field for resonance at 70 GHz. The results obtained from several related investigations are also reported. Author (TAB)

N67-22725# Air Force Systems Command Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOEMISSIVITY CHARACTERISTICS OF TRANSIENT METALS AND THEIR COMPOUNDS
G. V. Samsonov, Yu. B. Paderno, and V. S. Fomenko 4 Oct. 1966 14 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 10, no. 6, 1965 p 622–629
(FTD-HT-66-178; AD-645854) CFSTI: $3.00/MF $0.65

A discussion is given of the connection of the thermoemissive characteristics of transitional metals, their alloys and compounds with non-metals (boron, carbon, silicon and nitrogen) with the electronic structure of both the metal and non-metal. Dependences of the work function of metals, as well as of carbides, borides, nitrides and silicides, on the position of the elements in the periodic system are presented. Cases are considered of alloys of d-transitional metals, transitional metals with non-transitional (having outer s- and p-electrons), transitional metals with non-metals (boron, carbon, silicon, nitrogen). Proceeding from the results of the discussion, the conclusion may be drawn that the work function of the electrons substantially depends on the nature of filling of p - d electron states of metal atoms and on the degree of their stability. The value of the work function is, in addition, determined by the degree of non-filling of the electron states of transitional metals and ionization potential of the metalloid atom. The maximum values of the work function should belong to systems with completely or half filled stable states. The work function of electrons from metalloid refractory compounds is lowered as a result of a lesser degree of coupling of electrons with the cores of metal and metalloid atoms. This property in conjunction with the very high melting points permits creation of effective thermocathodes on their base. Author (TAB)

N67-22872* Georgetown Univ., Washington, D. C. Dept. of Physics.
THEORETICAL AND EXPERIMENTAL STUDIES OF RADIATION ABSORPTANCE AND EMITTANCE CHARACTERISTICS AND THEIR CONTROL FOR POTENTIAL SPACE VEHICLE SURFACE MATERIALS Final Report
Sep. 1966 95 p
(Grant NsG-428)
(NASA-CR-66326) CFSTI: $3.00 CSCL 20L

Optical and electrical properties of ZnS:$MnCl_2$ powders, and magnetic properties of ZnS:Mn:Cl were measured. The basic theory of electroluminescence, and the mechanism responsible for electroluminescence in the powders considered, are discussed. Some work was also done on the thermal control of spacecraft surface temperatures by means of electro-optical crystals. L.S.

N67-22998# Eidgenossische Technische Hochschule, Zurich (Switzerland).
THE EMISSION OF ELECTRONS FROM HOT SILICON SURFACES
A. Hamid Madjid (Ph.D. Thesis) 1965 34 p refs *Its* Dissertation No. 3672
CFSTI: HC $3.00/MF $0.65

The emission of electrons from hot silicon surfaces is reviewed in an effort to present a summary of the state of research in this field. The theoretical aspect of the problem is outlined briefly, and experimental results covering the temperature and field dependence of the saturation current density, as well as the anisotropy and the energy distribution of the emission are presented. Author

N67-23007 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SOME PROBLEMS CONNECTED WITH Nb_3Sn COATINGS ON Nb AS MATERIALS FOR SUPERMAGNET ELEMENTS [NIEKTORE PROBLEMY OTRZYNYWANIA Nb_3Sn JAKO MATERIALU NA ELEMENTY MAGNESOW NADPRZEWODZACYCH]

W. Rutkowski and Z. Horubala Sep. 1966 28 p refs
(INR-749/XIV/PS) CFSTI: $3.00

The paper deals with experiments conducted to develop a method of Nb_3Sn coated Nb strips production. The experiments data and results, as well as metallographic, rentgenographic and microhardness test results of the Nb–Sn diffusion layers are given. Author

N67-23051# Army Electronics Labs., Fort Monmouth, N. J.
EVALUATION OF PHOSPHINE-OXYGEN DIFFUSION SYSTEM AS A PROCESS FOR SILICON INTEGRATED CIRCUIT FABRICATION
J. S. Kesperis, R. S. Yatsko, J. A. Schweitzer, and N. O. Korolkoff Dec. 1966 26 p refs
(RCS-OSD-1366; ECOM-2785; AD-645508) CFSTI: HC $3.00/MF $0.65

Experimental conditions for the attainment of sheet resistance with high reproducibility at emitter doping levels have been obtained using the gaseous PH3-O2 process. Under these conditions, the deposition sheet resistance follows an activation energy relationship with temperature (with E = 2.9 eV between 1000 and 1100C), and is independent of background doping and oxygen concentration within pluse or minus 2.3% control limits. At temperatures below 1000C, there is an apparent dependence on both background doping and O2 concentration, and the process appears less saturated than that above 1000C. The two-step process shows that the final diffused sheet resistance and junction depth can be predicted from the deposition sheet resistance. The process has been successfully applied in the fabrication of emitters for integrated NPN transistors with no visible surface damage, and it is fully compatible and simple in operation. Author (TAB)

N67-23141# Michigan Univ., Ann Arbor. Willow Run Labs.
INFRARED STIMULATION OF LUMINESCENCE IN ZINC SULFIDE AT WAVELENGTHS LONGER THAN 3.5 MICRONS Information Note
Ojars Riegin and Allan C. Becker Jan. 1967 11 p refs
(Contract DA-280-043-AMC-00013(E))
(Rept.-6400-116-I; ECOM-00013-116; AD-645615) CFSTI: HC $3.00/MF $0.65

A conclusive experiment has been performed which shows that visible luminescence can be stimulated in a zinc sulfide phosphor by infrared radiation of 3.5 microns or longer. Author (TAB)

N67-23148# Naval Ordnance Lab., White Oak, Md.
THE NEEL TEMPERATURE OF MnF_2 IN THE TWO-SPIN CLUSTER-VARIATION LIMIT
Louis F. Libelo and Tomoyasu Tanaka 3 Oct. 1966 20 p refs
(NOLTR-66-193; AD-644897) CFSTI: HC $3.00/MF $0.65

The Neel temperature of MnF2 was calculated by application of the Cluster-Variation method in the two-spin limit. By treating the anisotropy energy as a quantity comparable to the exchange energy (as indicated by experiment) a considerable improvement over the molecular field value is obtained for T sub N. Author (TAB)

N67-23152# Rensselaer Polytechnic Inst., Troy, N. Y.
TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIALS Final Report, 1 Oct. 1965–30 Sep. 1966
John C. Corelli, Arthur R. Frederickson, and James W. Westhead Dec. 1966 89 p refs
(Contract DA-28-043-AMC-01788(E))
(ECOM-01788-F; Rept.-4; AD-644889) CFSTI: HC $3.00/MF $0.65

The transient behavior of the resistivity and Hall effect voltage in 1 to 100 ohm-cm n- and p-type silicon was studied both during and after exposing the sample to short bursts (0.01 to 4.5 microsec) of 48 MeV electrons. The buildup of excess electrons produced by ionization during the time the electron pulse is irradiating the sample appears to be dependent on the normal excess carrier decay rate. The injection levels induced by the bombarding electrons are high (delta n/n>1/10) and in most cases the excess carrier lifetimes exhibit an increase with higher injection level. The temperature dependence of induced conductivity as a function of injection is consistent with that predicted by theory. The transient Hall voltage response of 100 ohm-cm p-type silicon for high injection levels can be approximately reproduced by calculation assuming mixed hole-electron conduction and equal hole and electron decay times by a single time dependent exponential. A simple model is given which describes fast annealing in 45-50 MeV electron-irradiated silicon. TAB

N67-23153# Massachusetts Inst. of Tech., Cambridge.
SOLID-STATE AND MOLECULAR THEORY GROUP
John C. Slater et al 15 Jan. 1967 49 p refs
(Contract Nonr-1841(34); Grants NSF G-24908; NSF GP-3241)
(QPR-63; AD-646582) CFSTI: HC $3.00/MF $0.65

Contents: Calculations of charge and spin densities for iron, by P. DeCicco and A. Kitz; A preliminary note on symmetrizing the relativistic APW calculations, by D. Koelling; Electronic states of magnetic impurities in nonmagnetic metals, by J. Sokoloff; The A.P.W. Eigenfunctions for the deformed lattice, by J. F. Kenney. TAB

N67-23190# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
NEUTRONOGRAPHIC INVESTIGATION OF LOW-TEMPERATURE MAGNETIC TRANSITION IN CHROMIUM [NEITRONOGRAFICHESKIE ISSLEDOVANIYA NIZKOTEMPERATURNOGO MAGNITNOGO PREVRASHCHENIYA V KHROME]
R. A. Alikhanov and L. S. Smirnov 1965 16 p refs In RUSSIAN
(NP-16439; Rept.-393)

Neutronographic investigations of low-temperature magnetic transition were performed on polycrystallic chromium samples with an equal content of admixtures but with different thermo-mechanical treatment and on monocrystal samples using a miniature cryostat of original construction (530 g weight, 200 mm height). The rise of transition temperature with the metal plasticity increase was found. It was shown that the period of modulation spin density wave and its temperature dependence are the universal property of chromium. Author (NSA)

N67-23208# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
NEW CONCEPTS IN THE PHYSICS OF SOLIDS A Monograph
Johannes N. Peendl Aug. 1966 94 p refs *Its* Spec. Rept. No. 52
(AFCRL-66-541; AD-645890) CFSTI: HC $3.00/MF $0.65

This work treats spectral and atomistic concepts derived from an analytical study of more than one hundred solids. The study deals with such characteristics as infrared spectra, specific heat, bulk-modulus, change of compressibility with pressure, lattice anharmonicity, exponent of repulsion, lattice cohesive energy, zero-point energy, hardness, and valence. Characterizing the lattice vibrations - that is, the infrared spectrum through one single frequency (the centro-frequency, defined by the center of gravity of the entire spectrum) - it is shown that an identical frequency may be derived as a mechanical analogy from the average velocity of sound determined, in this case, from the cubic compressibility. A thermodynamical analogy exists in the Debye frequency from specific heat. The centro-frequency has proven to be the key to a successful formulation of the nonlinearity or anharmonicity of the

attractive and repulsive forces in solids. The importance of anharmonicity for the understanding of the basic properties of solids from an atomistic point of view is shown through various applications. Author (TAB)

N67-23221# Sandia Corp., Albuquerque, N. Mex.
TRANSIENT ANNEALING IN SEMICONDUCTOR DEVICES FOLLOWING PULSED NEUTRON IRRADIATION
H. H. Sander and B. L. Gregory Nov. 1966 27 p refs
(Contract AT(29-1)-789)
(SC-R-66-923) CFSTI: HC $3.00/MF $0.65

Transient annealing following pulsed neutron exposure was investigated in Si transistors and solar cells as a function of both irradiation temperature and injection level. Experiments incorporating x radiation and gamma rays demonstrated that transient annealing is a bulk, not a surface, effect. The observed annealing following neutron irradiation is considerably slower at low temperatures than at room temperature. At 213°K the density of annealable defects remaining at 10^{-4} sec after exposure is approximately three times that observed at this same time for a 300°K irradiation. The injection studies show that at any temperature from 76 to 300°K the presence of minority carrier injection considerably speeds the transient annealing processes. A model is presented which explains many of the features observed in transient annealing. Various kinetic processes are discussed in the derivation of this model, including diffusion-limited and generation-limited processes, and the results of the model are compared with experimental data. Author (NSA)

N67-23363# Pomona Coll., Claremont, Calif. Dept. of Physics.
MAGNETO-OPTICAL STUDY OF FERROMAGNETIC DOMAINS Final Report
Charles A. Fowler, Jr. 15 Jan. 1967 10 p refs
(Contract Nonr-1606(00))
(AD-645561) CFSTI: HC $3.00/MF $0.65

The scientific effort and the principal positive results achieved are reviewed briefly. Abstracts of the eight technical reports (no. 3 to no. 10 inclusive) are given, and the professional personnel and their major contributions to the project are cited. Also cited are the 18 students who have participated in the research project since its inception. Attention is called to future research, early stages of which are under way. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-22521# Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research.
STUDIES OF INTERNAL DISPLACEMENTS IN SOLID PROPELLANT GRAINS Interim Report, Jul.–Dec. 1966
E. Z. Stowell 15 Dec. 1966 37 p refs
(Contract Nonr-3363(00) FBM)
(AD-646017) CFSTI: HC $3.00/MF $0.65

The three principal stresses and strains are computed for a thick orthotropic hollow tube under internal pressure, using the bulk properties of the material. Consideration is given to the relations between the bulk properties and the properties of an individual reinforcing layer placed at an angle to the longitudinal axis of the tube. It is shown that when direct stresses are applied to the tube, there must be equal alternating plus and minus internal shear stresses from one reinforcing layer to another. Although these internal stresses are self-equilibrating when taken over the entire tube, the material of the tube must have sufficient strength in shear to be able to withstand these internal stresses. Direct stresses may be applied to the orthotropic tube by other means than by internal pressure. Some of these means are considered: by temperature difference between inside and outside, by bending of the tube during handling, and by acceleration. Any of the direct stresses generated by these means will give rise to internal shear stresses. Author (TAB)

N67-22785# Explosives Research and Development Establishment, Waltham Abbey (England).
THE USE OF CATALYTIC SURFACTANTS IN PLASTIC PROPELLANTS
B. C. Howard and J. Powling Dec. 1965 19 p refs
(ERDE-15/M/65; NAC/168/104; AD-477228) CFSTI: HC $3.00/MF $0.65

For the efficient use of burning rate catalysts in ammonium perchlorate-based propellants, it would seem desirable that the catalytic agent should be concentrated near the oxidizer surface rather than dispersed throughout the binder. In order to examine the idea and to achieve close, preferential association of catalyst and oxidizer, certain metal salts of dioctyl sulphosuccinic acid have been prepared and used in place of the sodium salt, which is a normal constituent of the surface-active agent used in plastic propellant compositions. Burning rates of plastic propellants containing the copper, iron, chromium and cuprammonium derivatives have been measured in the pressure range 200 to 2000 p.s.i.g. On the basis of the amount of metal present, the copper surfactant is two or three times as effective as copper chromate at low concentrations. However, the surfactant only contains 6.8 per cent of copper and on a total weight basis it is, of course, much less effective than copper chromate. Increasing the surface area of the ammonium perchlorate available to the catalytic surfactant did not increase the degree of catalysis. It was concluded that catalysis of redox reactions taking place within the perchlorate surface was less important than catalysis of gas phase reactions. Author (TAB)

N67-22786# Explosives Research and Development Establishment, Waltham Abbey (England).
THE COMBUSTION OF AMMONIUM PERCHLORATE-BASED COMPOSITE PROPELLANTS: DISCUSSION OF SOME RECENT EXPERIMENTAL RESULTS
J. Powling 13 Jul. 1965 42 p refs
(ERDE-15/R/65; AD-474311) CFSTI: HC $3.00/MF $0.65

Current experimental studies, at E.R.D.E. and elsewhere, on various aspects of the combustion of ammonium perchlorate-based propellants are discussed in relation to an accepted model for composite propellant burning. The nature of the chemical processes taking place at the solid/gas interface and the possibility of heat release in the condensed phase are considered. A summary of the results of surface temperature measurements on ammonium perchlorate burning under a variety of conditions from 0.8 to 300 p.s.i.a. is presented. Although the evidence is that some heat release is likely to occur within the solid surface, the combustion in all pressure regions appears to be dominated by gas phase reactions. Results with catalysts which are supposed to increase the extent of the condensed phase reaction do not alter this conclusion. Author (TAB)

N67-23318*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUEFIED NATURAL GAS AS A FUEL FOR SUPERSONIC AIRCRAFT
Richard J. Weber Washington, NASA, 1967 13 p refs Presented at the Am. Gas Assoc. Distribution Conf., St. Louis, 1–4 May 1967
(NASA-TM-X-52282) CFSTI: HC $3.00/MF $0.65 CSCL 21D

Current jet airplanes utilize kerosene or gasoline-type fuels. Liquid methane, however, is superior in terms of heating value, cooling capacity, and possibly cost. When it is applied to the difficult supersonic transport mission, payload capacity is estimated to increase by 30 percent, with a similar reduction in direct operating cost. Many problems must be solved before the concept can be considered to be feasible. If it is actually adopted, the airlines would consume up to six trillion cubic feet of natural gas per year. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-22452# Fairchild Stratos Corp., Bay Shore, N. Y.
APPLICATION OF A POWDER LUBRICATION SYSTEM TO A GAS TURBINE ENGINE, PART II Technical Report, Jun. 1965–Jun. 1966
Stanley Wallerstein and Lawrence Weissmann Dec. 1966 112 p refs
(Contract AF 33(615)-1331)
(AFAPL-TR-65-43, Pt. II; AD-645756) CFSTI: HC $3.00/MF $0.65

The objective of the program is to provide a powder lubrication system for a gas turbine engine. The report discusses experimental development testing of powder lubricated bearings, tested both in a specially designed bearing test rig and in a J-69 turbojet engine, modified for unfired operation with powder lubrication on a motor-driven test stand. The report summarizes the equipment, instrumentation, and experimental work carried on to attain quantitative and performance data on engine bearings as well as the powder lubrication delivery and exhaust system. Author (TAB)

N67-22566# Giannini Scientific Corp., Santa Ana, Calif.
ELECTROTHERMALLY ACCELERATED PLASMA JETS Final Technical Report, 1 Jun. 1965–31 May 1966
Adriano C. Ducati 30 Sep. 1966 105 p refs
(Contract AF 49(638)-1572)
(FR-096-1572; AFOSR-66-2726; AD-645119) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical results are presented on the performance characteristics of the low pressure arc jet operated with hydrogen. Thermal and thrust power efficiency have been measured for up to 20 kilogauss applied magnetic fields and various electrode configurations and specific impulses. The thermal efficiency is insensitive to magnetic field strength and specific impulse in the high range of specific impulse. Thrust efficiency shows a dependence on the magnetic field for operating conditions which produce values of the Hall parameter much larger than unity, but this may be due to the much discussed spurious interactions of the arc with the environment. The efficiencies show a definite and fairly regular increase with increasing arc chamber pressure. Tests have been conducted which demonstrate qualitatively the effect of the applied field on the arc current distribution. A good two-parameter fit of thermal efficiency data is given, and an analytical model for the thermal losses is partially developed. Explicit expressions for the torque on the arc jet flow are obtained for two classes of idealized current distributions. An inequality is derived which places a lower bound on the torque for a given applied magnetic field and electrode configuration. Author (TAB)

N67-22840*# National Aeronautics and Space Administration. Lewis Research Center Cleveland, Ohio.
EFFECT OF SIMULATED BEARING COOLANT INJECTION ON THE PERFORMANCE OF A TWO-STAGE, VELOCITY-COMPOUNDED TURBOPUMP DRIVE TURBINE
Roy G. Stabe, John F. Kline, and Edward H Gibbs Washington, NASA, Apr. 1967 17 p refs
(NASA-TM-X-1364) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The effect of simulated bearing coolant injection on the performance of a two-stage, velocity-compounded turbopump drive turbine has been investigated experimentally at the NASA Lewis Research Center. The turbine used for this investigation was the 0.646-scale-model turbine used for the cold-air performance evaluation of the M-1 fuel turbine (refs. 1 and 2). The blading for this turbine was designed with no provision for a secondary fluid flow. For the subject program, the bearing housing of the scale-model turbine was modified to provide for the introduction of measured amounts of secondary air into the space between the nozzle and the first-stage rotor disk to simulate bearing coolant injection. The secondary air mixes with the primary flow, also air, at the nozzle exit and proceeds through the remaining blade rows as part of the working fluid. Performance data were taken for one- and two-stage turbine configurations over a range of operating conditions and for four secondary flow rates of 0, 3, 7, and 10 percent of primary flow. Turbine performance in terms of static efficiency, equivalent specific work, and interstage static pressures are presented for the range of secondary flow rates covered in the investigation. The results of an analysis to determine the magnitude of the various turbine losses resulting from the secondary flow addition is also presented. Author

N67-23053# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT CONTACT HEAT EXCHANGE OF A PISTON WITH BUSHING DURING ENGINE OPERATION WITH NOMINAL LOAD
M. M. Burin 24 Aug. 1966 13 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 237, 1964 p 11–16
(FTD-TT-66-74; TT-67-60508; AD-645842) CFSTI: HC $3.00/MF $0.65

An examination was made of the course of the process of heat exchange in the zone of piston with bushing contact and certain ways of selecting the coefficient of heat transfer are given. Author (TAB)

N67-23104# Library of Congress, Washington, D. C. Aerospace Technology Div.
PROPULSION TECHNOLOGY Monthly Survey No. 2
Nov. 1966 62 p refs
(ATD-66-137; AD-646174) CFSTI: HC $3.00/MF $0.65

The report includes data on air breathing and rocket propulsion technology and the related nonchemical aspects of combustion. Author (TAB)

N67-23274*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
RL10A-3-3 ROCKET ENGINE OXIDIZER PUMP DEVELOPMENT PROGRAM, AUGUST 1965–JUNE 1966
A. J. Letson 30 Dec. 1966 91 p
(Contract NAS8-15494)
(NASA-CR-83547; PWA-FR-1890) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A program is described which was conducted to develop a rocket engine oxidizer pump configuration eliminating metal-to-metal rub of the inducer on the housings during all normal engine operation, without adversely affecting the overall pump performance. Details are given on oxidizer pump rig tests with increased inducer-to-housing clearances, a carbon insert rub ring,

and intentionally heavy inducer-to-housing rub rings; engine tests; design analysis; pump shaft and housing static deflection tests; and rub tests in liquid oxygen of the materials used in the oxidizer pump. It was found that the addition of a carbon insert to the inducer housing bore for a labyrinth seal rub ring eliminated the inducer-to-housing metal-to-metal rub and did not adversely affect pump performance. L.E.W.

N67-23310*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF A SUBMERGED NOZZLE FOR SOLID ROCKETS
Reino J. Salmi and James J. Pelouch, Jr. Washington, NASA, 1967 12 p For presentation at the 2d Solid Propulsion Conf., Anaheim, Calif., 6–8 Jun. 1967
(NASA-TM-X-52285) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Tests were conducted on an 0.07 scale compressed model of the 260-inch solid propellant rocket with a submerged nozzle to determine the velocity and direction of the exhaust flow in the annular channel. Results indicated that the asymmetric grain port shape induced a circumferential flow in annular passage between the submerged nozzle lip and the aft-end casing. Subsequent modifications to the SL-3 nozzle to provide increased insulation against the erosive effects of the hot exhaust gases in the annular channel also reduced the flow velocities in the channel. Simulated erosion of the grain due to burning also reduced the flow velocities in this region. Some flow distortion in the nozzle was also observed particularly with the 100% grain. R.N.A.

N67-23359# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATOMIC ROCKETS AND PROBLEMS IN THE CONQUEST OF SPACE
A. P. Senchenkov 23 May 1966 152 p Transl. into ENGLISH from the book "Atomnyye Rakety i Problemy Osvoyeniya Kosmosa" Moscow, Atomizdat, 1964 p 1–138
(FTD-MT-66-28; AD-645790) CFSTI: HC $3.00/MF $0.65

Contents: The atomic rocket; Electrical rocket engines and power problem; Space atomic electric power stations. TAB

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-22293*# Volt Technical Corp., Washington, D. C.
STUDY OF THE NUCLEAR COMPONENT OF PRIMARY COSMIC RAYS ABOARD AES "PROTON-2" [IZUCHENIYE YADERNOY KOMPONENTY PERVICHNYKH KOSMICHESKIKH LUCHEY NA ISZ "PROTON 2"]
N. N. Volodichev, N. L. Grigorov, V. E. Nesterov, and I. A. Savenko 21 Feb. 1967 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 1, 1967 p 115–118
(Contract NAS5-12487)
(NASA-CR-83562; ST-CR-NP-10566) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The results of measurements are described of the nuclear component of primary cosmic rays. These measurements have been carried out aboard AES Proton-2 with the aid of a Cerenkov spectrometer CEZ-1 during the 105 to 113 orbits of the satellite. Author

N67-22294*# Volt Technical Corp., Washington, D. C.
STEADY GEOMAGNETIC MICROPULSATIONS AND SOLAR CORPUSCULAR STREAMS [USTOYCHIVYYE GEOMAGNITNYYE MIKROPUL'SATSII I SOLNECHNYEE KORPUSKULYARNYYE POTOKI]
V. O. Bol'shakova 17 Feb. 1967 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 6, 1967 p 1089–1093
(Contract NAS5-12487)
(NASA-CR-83563; ST-GM-SP-10564) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A specific type of geomagnetic pulsation is juxtaposed with every type of solar corpuscular stream originating from the unperturbed regions of the Sun, from the active regions and from chromospheric flares. On the basis of the study of morphological properties of these types of pulsations conclusions are derived about the different geometry of the streams inducing these pulsations and the variation of the radiation intensity level of these various types of streams in the solar activity cycle. Author

N67-22489# International Centre for Theoretical Physics, Trieste (Italy).
RELATION BETWEEN PROTON-NUCLEUS AND PROTON-NUCLEON INTERACTION AT 20 GeV
W. E. Frahn (Cape Town Univ.) Dec. 1966 10 p refs Submitted for publication
(IC-66-120) CFSTI: HC $3.00/MF $0.65

It is shown that the parameters for proton-nucleus scattering at 19.3 GeV/c are closely related to those for proton-nucleon scattering at the same energy. Author (ESRO)

N67-22681# Pomona Coll., Claremont, Calif. Dept. of Physics.
DESIGN NOTES ON AN INTERMEDIATE RESOLUTION EXPERIMENT FOR THE MEASUREMENT OF THE ULTRASOFT X-RADIATIONS OF THE SOLAR CORONA
Burton L. Henke Sep. 1966 45 p refs
(Grant AF-AFOSR-685-64)
(AFOSR-66-2446; AD-645637) CFSTI: HC $3.00/MF $0.65

The report is a summary of notes on the design, calibration and reduction of data for a series of rocket-borne, spectroscopic measurements of solar coronal x-rays in the 15 to 45 A wavelength region. The measurements were made at solar activity minimum in May, July and August of 1964 on the Nike-Tomahawk low altitude rocket systems. Author (TAB)

N67-22918# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
SPECTROMETRY OF PRIMARY PROTONS AND OF SOLAR ORIGIN PROTONS AT SKOGAR, ICELAND (L APPROXIMATELY 6,7) [SPECTROMETRIE DE PROTONS PRIMAIRES ET DE PROTONS D'ORIGINE SOLAIRE A SKOGAR-ISLANDE (L APPROXIMATIVEMENT 6, 7)]
F. Cambou, J. C. Guyader, and H. Reme 1966 22 p refs In FRENCH Presented at the Inter-Union Symp. on Solar Terrest. Phys., Belgrade, 29 Aug.–2 Sep. 1966 Submitted for publication
CFSTI: HC $3.00/MF $0.65

The proton spectrometer used comprises a telescope made up of two scintillation counters and a Cerenkov counter which makes it possible to eliminate protons of greater energy than 1 GeV. The spectrum, measured on the basis of the specific energy loss of the particles in a thin cesium-iodide scintillator, is encoded and transmitted to a 100-channel amplitude analyser. The results presented relate to two balloon releases from Southern Iceland in the summer of 1965. The spectra obtained reveal the contributions made by protons of solar origin (19 Aug.) and by galactic primary protons (4 Sep.). Author (ESRO)

N67-22932# Centre d'Etude Spatiale des Rayonnements, Toulouse (France). Faculte des Sciences.
MEASUREMENT OF AURORAL X-RAYS [MESURE DU RAYONNEMENT X AURORAL]
F. Cambou, F. Cotin, and H. Reme May 1966 19 p refs In FRENCH Presented at the 7th Intern. Symp. on Space Sci., Vienna, May 1966
CFSTI: HC $3.00/MF $0.65

The X-ray spectrometer used comprises a scintillation counter equipped with a five-channel analyzer whose resolution time is of the order of a few milliseconds. The measurements are transmitted by means of one switched channel and three continuous channels. The results presented relate to two series of balloon releases made from Southern Iceland in August 1964 and August 1965, and they are correlated with the magnetic phenomena and the absorption. The spectra reveal periodicities of between 5 and 10 seconds for rapid pulses, and a periodicity of 0.6 second for micropulses. Author (ESRO)

N67-22996# Utrecht Observatory (Netherlands).
THE TRANSFER OF MECHANICAL ENERGY IN THE SUN AND THE HEATING OF THE CORONA. XVII (1)
M. Kuperus 1965 72 p refs
CFSTI: HC $3.00/MF $0.65

A compilation is given of the present state-of-the-theory in the generation and radiation of acoustic energy in the turbulent layer of the hydrogen zone. The effects that magnetic fields and the anisotropy of the turbulent motions have on the radiation of mechanical energy are briefly discussed, and the total mechanical energy flux is estimated. A schematization of the various types of wave motion is given, and a simple mechanism for the heating of the corona is described. The structure of the transition region between the chromosphere and the corona based on the propagation of the mechanical energy flux in the form of shock waves is outlined. Observations of the physical state of a coronal center of activity are reviewed, and a heating mechanism is derived and applied to stars of spectral type and luminosity other than the sun. C.T.C.

N67-23068 National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Oct. 1966 12 p Prepared for the Radio Res. Comm. of the Council of Sci. and Ind. Res.
(IRRC-A-135, Pt. 2) CFSTI: $3.00

Tabulated solar and geophysical data obtained with vertical incidence soundings during August 1966 from Indian stations are presented. Included are lists of the participating stations and cooperating organizations, as well as tables on predicted sunspot numbers, observed sunspot numbers, optical observations of solar flares, solar flux, solar flare effects, magnetic storms, and ionospheric effects of solar flares. R.N.A.

N67-23117# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
DERIVATIONS OF GEOMAGNETIC SHELL EQUATIONS Technical Report, Feb. 1960–Mar. 1961
Ralph H. Pennington Jan. 1967 35 p ref
(AFWL-TR-66-152; AD-645940) CFSTI: HC $3.00/MF $0.65

A set of formulas was derived relating to charged particle shells in a geomagnetic field represented by a dipole and distortions of small magnitude. Recent interest in the use of computer codes in solving problems of trapped radiation in space has emphasized the need for publishing such formula derivations. Author (TAB)

N67-23250*# Volt Technical Corp., Washington, D. C.
MEASUREMENTS OF KILOMETER COSMIC RADIOEMISSION IN INTERPLANETARY SPACE [IZMERENIYA KILOMETROVOGO KOSMICHESKOGO RADIOIZLUCHENIYA V MEZHPLANETNOM PROSTRANSTVE]
V. I. Slysh 9 Feb. 1967 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, issue 6, 1966 p 923–931
(Contract NAS5-12487)
(NASA-CR-83524; ST-RA-RWP-10560) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Data have been obtained on the intensity of low-frequency radioemission in interplanetary space according to measurements of that emission from inter-planetary probes (AIS) Zond-2, Zond-3 and Venera-2 in the 20 to 2200 kc/sec frequency band. The intensities measured in the frequencies of 985, 2000 and 2200 kc/sec are in agreement with the measurements of the galactic background performed by other authors. In the 210–220 kc/sec band the spectrum increases steeply toward the side of low frequencies; the variation of intensity with distance, the observation of interference lobes and, possibly, that of occultation by the Moon, point to Jupiter as being an emission source, at least in the frequency of 200 kc/sec. The occultation by the Moon took place in the presence of differential refraction in the upper ionosphere. In the very lowest frequencies of 20 and 30 kc/sec the observed radioemission may also be conditioned by the schrot effect of interplanetary electrons. The radioemission spectrum of Jupiter in kilometer waves agrees well with Jupiter's spectrum of decameter radioemission. Author

N67-23256*# Volt Technical Corp., Washington, D. C.
CALCULATION OF CERTAIN CHARACTERISTICS OF EXTENDED AIR SHOWERS IN THE LOWER PART OF THE ATMOSPHERE FOR LARGE FLUCTUATIONS OF THE ELEMENTARY ACT [RASCHET NEKOTORYKH KHARAKHTERISTIK SHIROKIKH ATMOSFERNYKH LIVNEY V NIZHNEY CHASTI ATMOSFERY PRI BOL'SHIKH FLUKTUATSIYAKH ELEMENTARNOGO AKTA]
R. A. Nymmik and V. A. Shestoperov 21 Mar. 1967 15 p refs Transl. into ENGLISH from Yadern. Fiz. (Moscow), v. 5, issue 2, 1967 p 357–368
(Contract NAS5-12487)
(NASA-CR-83530; ST-AI-NP-10581) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Certain characteristics of extended air showers (EAS) are calculated in the assumption that the inelasticity coefficient and the multiplicity of particles produced in the interactions of protons with the nuclei of air atoms vary considerably from case to case. The role of interactions with a large inelasticity coefficient in the development of EAS is considered. Results are given of calculations of energy distribution of primary protons generating EAS with a given number of particles, and of energy flux in the electron–proton and the nuclear-interacting components of EAS. Author

N67-23257*# Volt Technical Corp., Washington, D. C.
MEASUREMENT OF THE ENERGY SPECTRUM OF PRIMARY COSMIC RAYS IN THE ENERGY REGION FROM 10^{10}–10^{14} eV WITH THE HELP OF AES PROTON-1 [IZMERENIYE ENERGETICHESKOGO SPEKTRA PERVICHNYKH KOSMICHESKIKH LUCHEY V OBLASTI ENERGIY 10^{10}–10^{14} eV S POMOSHCH'YU ISZ PROTON-1]
N. L. Grigorov, O. M. Kovrizhnykh, and V. E. Nesterov 7 Mar. 1967 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 30, no. 11, 1966
(Contract NAS5-12487)
(NASA-CR-83531; ST-CR-10574) CFSTI: HC $3.00/MF $0.65 CSCL 20H

This experiment, carried out aboard the heavy AES Proton-1, was designed to measure the energy spectrum of primary cosmic rays in the high energy range. So far this could not be performed

by direct measurements. The measurements were conducted with the aid of a type SEZ-14 ionization calorimeter. The results presented here cover only a part of the material collected during satellite's lifetime and are therefore preliminary. Author

N67-23268*# Volt Technical Corp., Washington, D. C.
RELICT RADIATION OF THE UNIVERSE AND POPULATION OF ROTATION LEVELS OF INTERSTELLAR MOLECULES [RELIKTOVOYE IZLUCHENIYE VSELENNOY I NASELENNOST' VRASHCHATEL'NYKH UROVNEY MEZHVEZDNYKH MOLEKUL]
I. S. Shklovskiy 23 Feb. 1967 4 p refs Transl. into ENGLISH from Astron. Tsirkular No. 364 of the Akad. Nauk SSSR, 23 Mar. 1966
(Contract NAS5-12487)
(NASA-CR-83532; ST-IGA-NP-10567) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The author establishes that there is a foundation for the assertion that relict radiation of the universe was discovered as early as a quarter of a century ago, but remained unintelligible till recently. In the current note the author discusses the influence of that radiation on the rotational temperature of interstellar molecules. Author

N67-23280*# Volt Technical Corp., Washington, D. C.
POSSIBILITY OF DETERMINATION OF RELATIVISTIC PROTONS' CONTENT IN SOME SOURCES OF SYNCHROTRON RADIATION [VOZMOZHNOST' OPREDELENIYA SODERZHANIYA RELYATIVISTSKIKH PROTONOV I ELEKTRONOV V NEKOTORYKH ISTOCHNIKAKH SINKHROTRONNOGO IZLUCHENIYA]
I. S. Shklovskiy 21 Feb. 1967 5 p refs Transl. into ENGLISH from Astron. Tsirkular No. 364 of the Akad. Nauk SSSR, 29 Mar. 1966
(Contract NAS5-12487)
(NASA-CR-83534; ST-IGA-PF-10565) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A new method is proposed to determine, at least for certain sources, the content of relativistic protons and electrons in synchrotron radiation. The method is based upon the recently revealed "relict" radioemission filling the entire metagalaxy. The generation of hard X-ray quants (inverse Compton effect) is the result of interaction of relativistic electrons in the sources of synchrotron radioemission with the "relict photons". Author

N67-23276* Maryland Univ., College Park. Dept. of Physics and Astronomy.
ACCELERATION OF COSMIC RAYS IN INTERPLANETARY SPACE BY FRICTION WITH THE SOLAR WIND
A. M. Lanchek and M. Goldstein Oct. 1966 25 p refs
(Grants NsG-58-60; NsG-695)
(NASA-CR-83549; TR-630) CSCL 20H

The interaction between galactic cosmic rays and the steady solar wind is studied. In the steady state the cosmic rays form a stationary cosmic ray gas through which massive magnetic irregularities are carried by the solar wind. Collisions between the streaming irregularities and the stationary cosmic ray gas transfer energy and momentum to the cosmic rays. The cosmic ray gas in the solar environment is thereby heated by friction with the solar wind that flows through it. In the steady state the average cosmic rays near the earth are more energetic than they were in interstellar space by a factor that is less than three. ..... Author

N67-23320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ORDERED MAGNETIC FIELD OF THE MAGNETOSHEATH
D. H. Fairfield Apr. 1967 38 p refs
(NASA-TM-X-55750; X-612-67-174) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Simultaneous data from the IMP 1 and IMP 2 satellites revealed that magnetic field discontinuities seen at one satellite are subsequently seen at the other with delay times consistent with the idea of magnetic fields frozen in the solar wind being convected away from the sun with the solar wind velocity. A one to one correspondence of discontinuities at the two satellites persists even when one satellite is in the magnetosheath, showing that interplanetary fields are convected into the magnetosheath. Analysis of the directional distribution of magnetosheath fields and their relation to simultaneously measured interplanetary fields shows that as the magnetosheath fields are convected around the magnetopause by the solar plasma they undergo distortion from their interplanetary values until they are aligned tangent to the magnetopause. A hydromagnetic interpretation is that interplanetary field lines, after being convected through the earth's bow shock, become draped around the magnetosphere with the sense of the magnetosheath field being that of the incoming interplanetary field. Author

N67-23326*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
PROTON–ELECTRON SPECTROMETER EXPERIMENTS ON GEMINI-4 AND GEMINI-7 Final Report, 27 May 1963–30 Sep. 1966
J. B. Reagan, J. C. Bakke, M. A. Heinemann, W. L. Imhof, and R. V. Smith 30 Sep. 1966 94 p refs
(Contract NAS9-1587)
(NASA-CR-65604; LMSC-2-44-66-1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This report describes two experiments which were performed aboard the Gemini-4 and Gemini-7 spacecraft to measure the external radiation environment. Omnidirectional fluxes and spectra of electrons in the 0.5–8.0-MeV energy range and of protons in the 25–80-MeV energy range as well as the omnidirectional proton flux greater than approximately 80 MeV were measured by scintillation spectrometers employing 16-channel pulse-height analyzers. A detailed description of the spectrometers including design philosophy, laboratory and in-flight calibration, and flight performance is included. Preliminary results from the experiments in the form of proton and electron flux contours and spectral shapes in B,L space are given. A comparison between the present data and previous experimental and theoretical results is also included. Proposed additional detailed data analysis is suggested. Author

N67-23468# Minnesota Univ., Minneapolis. Cosmic Ray Group.
RESOURCE BIBLIOGRAPHY ON COSMIC RAYS AND RELATED SUBJECTS
J. R. Winckler and D. J. Hofmann Dec. 1966 63 p refs
(CR-89)

An annotated bibliography is presented which contains references to material in the field of cosmic radiation and related subjects. Included are references to original papers representing milestones in cosmic ray research, review articles, published cosmic ray symposia, books on cosmic rays or related subjects, popular books and articles, chapters in physics text books, and films on cosmic rays and related subjects. The appendices contain a list of review articles, books, and conference proceedings on solar physics; and a reference to a comprehensive bibliography in the particles and fields area. R.N.A.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-22073*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BALLOON SOLAR OBSERVATORY SYSTEM
Paul Fahlstrom et al Apr. 1966 98 p
(NASA-TM-X-55711; X-732-66-147) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The design, development and testing of a relatively inexpensive balloon solar observatory system suitable for scientific experiments where pointing accuracy is not paramount are described. The system functions in two primary modes: solar and computer. The solar mode is used to point an experiment to the center of the sun and has an accuracy of better than ±1 degree. The computer mode is used to point an experiment toward any selected points in the celestial sphere, without benefit of radiating stimuli, and has an accuracy of better than ±3 degrees over a period of 10 hours. In addition to the primary modes of operation, there are a number of secondary modes such as back-azimuth, launch-recovery, etc. Photographs of the system are shown. Author

N67-22100# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ANALYTICAL PERTURBATION THEORY IN RELATION TO THE THREE BODIES PROBLEM APPLYING THE REGULATING VARIABLES [ANALYTISCHE STOERUNGS-THEORIE IM DREIKOERPERPROBLEM MIT HILFE VON REGULARISIERENDEN VARIABLEN]
Max Roessler (Ph.D. Thesis) 1966 69 p refs In GERMAN
(Rept.-3772) CFSTI: HC $3.00/MF $0.65

The smoothing equations are derived and adapted to the perturbation theory, followed by the development of the perturbation terms by means of variables. The resulting convergence is satisfactory even for extremely eccentric trajectories, which is contrary to the usual development toward the mean anomalies experienced in the classical theory. Unlike previous theories, the method also permits analytical inclusion of collision trajectories. The solution is in the form of a Fourier double series fixing the positions of the bodies of motion and perturbation in their undisturbed Kepler paths. Numerical solutions are presented for several examples. Computations were performed on a CDC 1604 A computer. Good agreement with other theories was noted for a computed perturbation of the planetoid Vesta by Jupiter. Transl. by K.W.

N67-22172*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROBLEMS AND TECHNIQUES OF LUNAR SURFACE MINING
S. A. Fields, H. M. Weathers, R. M. Cox, and R. O. Shotts (Alabama Univ.) 10 Jan. 1967 50 p refs
(NASA-TM-X-53580) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Laboratory experiments and test programs indicate that the physical characteristics of lunar surface materials may differ in several respects from those of terrestrial rocks and soils. The vacuum environment was shown to have a pronounced effect upon porosity, bearing strength, adhesion, and the frictional characteristics of simulated lunar surface materials. Studies were made of several surface mining methods which could be adapted for use on the moon. The requirements for power, manpower, and ore production were considered in rejecting certain systems commonly used on earth. Crew safety, weight and delivery costs, simplicity of operation, and mine operations were other factors which further restricted the remaining systems to the ones presented. These preliminary studies indicate that surface mining may be advantageous if the space program becomes large enough to require extensive lunar exploration or planetary exploration from a lunar base or colony. Author

N67-22280*# Melpar, Inc., Falls Church, Va.
STUDY IN COMETARY ASTROPHYSICS Quarterly Report, Nov. 20, 1966–Feb. 20, 1967
10 Mar. 1967 31 p refs
(Contract NASw-1417)
(NASA-CR-83398) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Emission spectra produced by electron bombardment of low pressure gases are being studied. The selective production of C_3 or C_2 from simple molecules may have important cometary implications and the production of C_3 from CH_4 is considered to occur by a very rapid reaction. The intensity of the C_3 emission was found to increase in experiments using low energy electrons. Studies of the rate of the collisional interchange of the singlet and triplet states of C_2 are continuing. Measurements in shock heated cyanogen show that the singlet state is produced more rapidly than the triplet state. Photochemical decomposition in the far ultraviolet of methylacetylene at low pressure, leading to the formation of molecular hydrogen, atomic hydrogen and acetylene, was initiated. Molecular hydrogen formation assumes increasing importance relative to other processes at shorter wavelength. Direct production of C_2 from methylacetylene appears to be considerably less important than it is in the decomposition of acetylene or diacetylene. Author

N67-22287*# Volt Technical Corp., Washington, D. C.
INTENSITY VARIATIONS OF H ALPHA AND [N II]6583 A LINES IN THE NIGHT SKY SPECTRUM [SUR LES VARIATIONS D'INTENSITE DES RAIES Hα AND [N II] 6 583 A DANS LE SPECTRE DU CIEL NOCTURNE]
15 Mar. 1967 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Astrophys. et Aeronomie (Paris), Aug. 1961
(Contract NAS5-12487)
(NASA-CR-83561; ST-AP-AE-SPC-10578) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The strong intensity variations of the lines H_α and [N II] 6 583 A in the spectrum of the night sky are often the result of passage of galactic regions H II in the field of spectrographs. The line H_α, emitted in the interplanetary space or, more probably, in the upper atmosphere, can be isolated only outside the Milky Way. Author

N67-22300*# Volt Technical Corp., Washington, D. C.
INVESTIGATION OF METEORIC DUST WITH THE AID OF ROCKETS AND SATELLITES [ISSELDOVANIYA METEORNOY PYLI S POMOSHCHYU RAKET I SPUTNIKOV]
T. N. Nazarova 1 Feb. 1967 13 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 6, 1966 p 900–909
(Contract NAS5-12487)
(NASA-CR-83565; ST-IM-10558) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The results are presented of meteoric dust investigation with the help of rockets and Earth's artificial satellites for the period from 1957 to 1966. Measurements of spatial density of meteoric particles were conducted with the aid of piezoelectric sensors along flight trajectories of spacecrafts in the vicinity of the Earth, and also in the direction from Earth's orbit toward and from the Sun. Author

N67-22486# Royal Aircraft Establishment, Farnborough (England).
AN APPLICATION OF METHODS OF FUNCTION MINIMIZATION TO A PROBLEM OF NON-LINEAR CURVE FITTING ARISING IN THE ESTIMATION OF GEOPHYSICAL CONSTANTS FROM SATELLITE OBSERVATIONS
B. A. M. Piggott Aug. 1966 22 p refs
(RAE-TR-66260)

Observations of the mean longitude of two nearly synchronous satellites, Syncom 2 and Syncom 3, have been used to estimate the parameters associated with the most important longitude-dependent terms in the expansion of the earth's gravitational field. This was done by solving a nonlinear least squares curve fitting problem using function minimization techniques, and

the efficiencies of a number of these techniques were compared. Estimates of the accuracy of the parameter values obtained were found from a linearized model. Author (ESRO)

N67-22504# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULKOVO. NEWS OF THE ASTRONOMICAL OBSERVATORY
17 Jun. 1966 112 p refs Transl. into ENGLISH from Pulkovo. Astron. Observ., Izv., v. 23, no. 5, 1964 p 121–166 (FTD-HT-66-184; AD-645785) CFSTI: HC $3.00/MF $0.65

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2. CERTAIN POSSIBILITIES OF UTILIZING PHOTOELECTRIC AND TELEVISION METHODS FOR COMBATING NOISE FROM ATMOSPHERIC TURBULENCE DURING ASTRONOMICAL OBSERVATIONS N. F. Kuprevich p 50–80 refs (See N67-22506 11-30)

3. VARIABILITY OF THE ASTROCLIMATE G. I. Bol'shakova and Sh. P. Darchiya p 81–94 refs (See N67-22507 11-30)

4. FAST, WIDE ANGLE TELESCOPE OF LARGE DIAMETER T. S. Belorossova, D. D. Maksutov, N. V. Merman, and M. A. Sosnina p 95–104 refs (See N67-22508 11-14)

N67-22506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN POSSIBILITIES OF UTILIZING PHOTOELECTRIC AND TELEVISION METHODS FOR COMBATING NOISE FROM ATMOSPHERIC TURBULENCE DURING ASTRONOMICAL OBSERVATIONS
N. F. Kuprevich *In its* Pulkovo. News of the Astron. Obs. 17 Jun. 1966 p 50–80 refs (See N67-22504 11-30) CFSTI: HC $3.00/MF $0.65

A number of photoelectric and television devices designed to combat atmospheric noise during astronomical observations are described. Schematics and descriptions are given for devices constructed with the use of automatically operating photographic shutters controlled by photocurrent from an electron amplifier. Systems using television techniques include the telecrascope, a compensator for noise from atmospheric turbulence, the eudophor, and a television compensator. Certain conclusions and predictions concerning future work in these directions are discussed. Author

N67-22507# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VARIABILITY OF THE ASTROCLIMATE
G. I. Bol'shakova and Sh. P. Darchiya *In its* Pulkovo. News of the Astron. Obs. 17 Jun. 1966 p 81–94 refs (See N67-22504 11-30) CFSTI: HC $3.00/MF $0.65

A detailed analysis of changes in image quality (characterized by the angle of turbulence t_0) for various points from 1955 through 1962 is given. A tendency towards repetition in large and small values of the angle of turbulence over a definite interval of time as well as the effect of solar activity on the quality of star images are shown. Author

N67-22511*# Arizona Univ., Tucson.
COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 5, PART 3, NO. 72–78
G. P. Kuiper, ed. 1966 127 p refs
(Contract AF 19(628)-4332) CFSTI: HC $3.00/MF $0.65 CSCL 03A

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7. SELENODETIC MEASURES ON YERKES LUNAR PHOTOGRAPH NO. 482 D. W. G. Arthur p 41–43 refs (See N67-22518 11-30)

N67-22512*# Arizona Univ., Tucson.
THE INITIAL REDUCTIONS OF MEASURES ON STAR-TRAILED LUNAR PHOTOGRAPHS
D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 7–11 (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

Full details are given for the initial reductions of measures on star-trailed lunar photographs. These reductions determine refraction-free photographic coordinates of limb profile points and points on the disk. These coordinates are referred to axes with the origin at the center of the bright limb with the y-axis directed along the moon's hour circle. Author

N67-22514*# Arizona Univ., Tucson.
SCALE TRANSFER FOR LUNAR PHOTOGRAPHS
D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 17–18 refs (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

A method is described for transferring scale from one lunar photograph to another. Selenodetic controls are used, and the effects of systematic and random errors in the positions of the selenodetic points are largely eliminated by choosing a suitable pattern of points. The transfer errors are of the same order as those generally met in selenodetic measures. Author

N67-22515*# Arizona Univ., Tucson.
THE VALIDITY OF SELENODETIC POSITIONS
D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 19–30 refs (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

Evidence is presented that strong systematic errors in the earthward coordinates of selenodetic points are introduced at all stages of selenodetic triangulation, that is, in the fundamental point determination from heliometer measures, in the determinations of the secondary points, and in the tertiary or photographic triangulations. In contrast, the best photographic triangulations show virtually no evidence of system in the coordinates parallel to the plane of the limb. Author

N67-22516*# Arizona Univ., Tucson.
A METHOD FOR DETERMINING THE MOON'S CONSTANTS OF ROTATION FROM MEASUREMENTS ON SCALED AND ORIENTED LUNAR PHOTOGRAPHS

D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 31–36 refs (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

A method is described for determining the moon's constants of rotation and the selenodetic coordinates of a number of primary points starting from rectangular coordinate measures on scaled and oriented lunar photographs. The new features are the use of Mösting A as the origin of selenodetic coordinates and the employment of rigorous formulas in place of the approximate differential formulas of classical selenodesy. The least squares analysis takes into account the algebraic correlation introduced in the reductions of the observed points. Author

N67-22517*# Arizona Univ., Tucson.
SELENODETIC MEASURES ON YERKES LUNAR PHOTOGRAPH NO. 1269
D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 37–38 ref (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

Details are given of the measures and reductions for 1868 points on Yerkes lunar photograph No. 1269. The catalog lists the uncorrected photographic coordinates, the refraction-free photographic coordinates, and the standard direction-cosines of 1464 points on the disk. Also given are the uncorrected coordinates and the refraction-free photographic rectangular and polar coordinates of 404 points on the bright limb. Author

N67-22518# Arizona Univ., Tucson.
SELENODETIC MEASURES ON YERKES LUNAR PHOTOGRAPH NO. 482
D. W. G. Arthur *In its* Commun. of the Lunar and Planetary Lab. 1966 p 41–43 refs (See N67-22511 11-30) CFSTI: HC $3.00/MF $0.65

Details are given of the measures and reductions for 1438 points on Yerkes lunar photograph No. 482. The catalog lists the uncorrected photographic coordinates, the refraction-free coordinates, and the standard direction-cosines of 990 points on the disk. Also given are the uncorrected coordinates and the refraction-free photographic rectangular and polar coordinates of 448 points on the bright limb. The disk and limb surveys are incomplete because of plate damage. Author

N67-22532# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADIO PHYSICS AND ASTRONOMY, 1 DECEMBER 1965–31 MAY 1966
Marion L. Meeks and Victor C. Pineo, ed. 19 Dec. 1966 112 p refs
(Contract AF 19(628)-5167)
(ESD-TR-66-446; AD-645324) CFSTI: HC $3.00/MF $0.65

The report covers research in the fields of radio physics and astronomy at Lincoln Laboratory for the period from 1 December 1965 through 31 May 1966. In a few cases, material from earlier work is introduced to clarify the discussion of a current program, e.g., Experimental Evaluation of a 1000-Wavelength Antenna. Twenty-three papers presenting work by the Radio Physics, Communications, Solid State and Radar Divisions of Lincoln Laboratory and by the M.I.T. Research Laboratory of Electronics with the cooperation of Lincoln Laboratory are included. Twenty of the papers discuss work involving the Millstone Hill Field Station which is the Laboratorys primary facility for experimental research in radio physics and astronomy. Two papers describe the 28-ft millimeter research facility (1000 wavelength) at Lincoln Laboratory in Lexington and one is a theoretical paper on scattering from objects with irregular surfaces. Author (TAB)

N67-22563# *RAND Corp., Santa Monica, Calif.*
A NEW APPROACH TO THE AUXILIARY EQUATION WITH APPLICATION TO THE GREENHOUSE EFFECT
H. H. Kagiwada, R. E. Kalaba, and Rupert Wildt Jan. 1967 20 p refs
(Contract AF 44(640)67-C-0045)
(RM-5076-PR; AD-645565) CFSTI: HC $3.00/MF $0.65

Part of the heating of the atmosphere is due to the fact that the incident solar radiation has one absorption coefficient and the escaping planetary gas another. This is referred to as the greenhouse effect. An idealized theory of the greenhouse effect for a gray planetary atmosphere of infinite depth was developed by R. Wildt of Yale University in previous work. Numerical results for the temperature profile were given. These employed accurate numerical values for the Hopf q function and the Chandrasekhar H function, which are now available. This memorandum shows how to treat the problem for the case of an atmosphere of finite depth. First an initial value problem for the basic integral equation for the source function is obtained. Then an effective numerical procedure is described, and some computational results are presented. Author (TAB)

N67-22565# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
STABILITY OF THE TRIANGULAR LAGRANGIAN POINTS
A. Deprit Nov. 1966 28 p refs *Its* Math. Note No. 492
(D1-82-0580; AD-645547) CFSTI: HC $3.00/MF $0.65

Leontovich has proved that the triangular equilibrium positions in the planar Restricted Problem of Three Bodies are stable for almost all admissible mass ratios. It is shown here that the set of exceptional mass ratios for which stability remains to be proved or invalidated contains only one point besides the critical mass ratios of order two and three. Author (TAB)

N67-22577# RAND Corp., Santa Monica, Calif.
INTRODUCTORY COMMENTS ON VENUS LOWER ATMOSPHERE
D. Deirmendjian Jan. 1967 10 p Presented at Conf. on the Atmospheres of Mars and Venus, Tucson, Ariz., 28 Feb. 1967
(P-3513; AD-645956) CFSTI: HC $3.00/MF $0.65

The difficulties in distinguishing between an upper and lower Venusian atmosphere are pointed out. The lack of reliable basic data, such as surface pressure and temperature, temperature gradients, gaseous and particulate composition, large and small scale air motion, related to the denser parts of the atmosphere are noted. The wide variation of surface pressure estimates, ranging between 3 and 1000 atmospheres, advanced by various authors recently is displayed graphically. No critique of these is attempted because the corresponding models are not sufficiently well defined nor thoroughly analyzed. Author (TAB)

N67-22645*# Massachusetts Inst. of Tech., Cambridge.
RADIO ASTRONOMY
A. H. Barrett, B. F. Burke, L. B. Lenoir, D. H. Staelin, S. H. Zisk et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 33–48 refs (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Contracts NSR-22-009-120; DA-36-039-AMC-03200(E); Grant NsG-419)

A brief summary is given on studies of continuum emission of extraterrestrial radio sources, the radio spectrum of the interstellar medium, and microwave emission and absorption by the terrestrial atmosphere and surface. Results of observations of OH emission with an interferometer comprising the Haystack and Millstone antennas have been extended to include the positions and angular sizes of the emission regions associated with W49, NGC 6334, and Sagittarius. Brief consideration is given to an experiment in which an 84-ft antenna and a 60-ft radio telescope are being used as an interferometer. Preliminary observations have revealed fringes at 1665 Mc/sec. The average solar brightness temperatures of the center of the sun, measured with a 5-channel K-band

radiometer, are tabulated. Details are also given on the inference of atmospheric attenuation near 61.15 GHz from balloon flight results and observations of microwave emission from atmospheric oxygen during balloon experiments in summer 1965. L.E.W.

N67-22715# Royal Aircraft Establishment, Farnborough (England).
SOME CONVENIENT FORMULAE FOR THE TRAJECTORY OF A SPACE PROBE APPLIED TO LUNIK I
G. B. Longden Jul. 1963 50 p refs
(RAE-TN-SPACE-40) CFSTI: HC $3.00/MF $0.65

The note extends, to a missile flying on a hyperbolic orbit, trajectory formulae which proved most convenient in ballistic missile experience. Expressions are given for height, velocity, and flight time in terms of angular position, initial height, and velocity. These expressions together with those on accuracy are illustrated by using some of the facts published about Lunik I to deduce the approximate trajectory in the neighborhood of the earth and the moon. Author

N67-22719# Royal Aircraft Establishment, Farnborough (England).
GRAVITATIONAL PERTURBATIONS OF BALLISTIC MISSILE TRAJECTORIES. V. TIME OF FLIGHT OVER A SPHEROIDAL EARTH
M. F. C. Woollett and R. B. Law Jul. 1963 90 p refs
(RAE-TN-WE-36) CFSTI: HC $3.00/MF $0.65

This note examines the first-order effect of earth oblateness upon the flight time of a ballistic missile. It is shown that the dependence of the effect upon the shape and size of the trajectory is quite separate from its dependence upon the position and direction and, as a result, can be summarized in a particularly simple formula. Two methods of evaluating this formula are described: the first is precise, but requires the resources of a digital computer; the second is by means of approximations simple enough for use with a desk calculating machine. A selection of graphs is given, illustrating the changes in flight time for trajectories having ground ranges up to about 5000 nautical miles and initial climb angles up to 70°. Author

N67-22731# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
REVIEW OF LUNAR INFRARED OBSERVATIONS
J. M. Saari and R. W. Shorthill Dec. 1966 51 p refs Presented at the Symp. on the Physics of the Moon, Washington, D. C., 29 Dec. 1966
(D1-82-0586; AD-645548) CFSTI: HC $3.00/MF $0.65

Prior to 1960 the lunar surface was known to be highly insulating from the low temperatures observed during an eclipse and the lunar night. Directional effects in the infrared emission from the illuminated surface were understood to result from roughness. In 1960, a number of ray craters were shown to cool more slowly than their environs during an eclipse. Subsequently, this behavior was observed during the lunar night for both ray craters and certain other features. In 1964, the entire disk was scanned during a total eclipse, revealing the presence of hundreds of hot spots. These anomalies have been identified with a variety of geological features. The current status of the thermophysical and geological interpretations of this discovery is discussed. Author (TAB)

N67-22873*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR OCCULTATION OF 3C 132
Larry W. Brown Apr. 1967 11 p refs
(NASA-TM-X-55745; X-615-67-165) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The diameter and position of radio source 3C 132 has been determined by means of a lunar occultation. A probable optical identification with a red galaxy has been confirmed. Author

N67-22964 Radio and Space Research Station, Slough (England).
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR JULY 1966
1966 48 p *Its* Issue No. 27
CFSTI: HC $3.00

Tabulated data of time, azimuth, and elevation for satellites observed during July 1966. N.E.N.

N67-22965# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
GRAPHICALS METHODS FOR ORBIT CALCULATIONS OF SATELLITES [GRAPHISCHE METHODEN ZUR ERMITTLUNG DER BAHNEN VON ERDSATELLITEN]
E. Baeger Jan. 1967 68 p refs In GERMAN
(DLR-FB-67-03) CFSTI: HC $3.00/MF $0.65

Radio observation of an artificial earth satellite is only possible if, for the location of the observer, the orbit of the satellite concerned is known. The present paper recapitulates the absolutely necessary astronomical facts and informs on simple graphical methods of orbit prediction for communication engineers who are engaged in satellite reception. In addition to the well-known method with cylinder projections of the terrestrial globe, an additional method with calculating disks is described which was worked out in connection with the project of a scientific ground station. This method has been found to be a useful tool for calculating orbits. Author

N67-23094# Royal Aircraft Establishment, Farnborough (England).
SYMMETRY OF A GEOCENTRIC DUST BELT AND THE ZODIACAL LIGHT
R. R. Allan and G. E. Cook Aug. 1966 11 p refs
(RAE-TR-66257) CFSTI: HC $3.00/MF $0.65

The behavior of dust particles in geocentric orbits is discussed. An approximate analytical solution can be found for the motion under gravitational forces alone if the orbital eccentricity is small, and a plane of symmetry can be defined if the lunar orbit is assumed fixed. Solar radiation pressure is important for dust particles and its effect is to change the position of the plane of symmetry so that it lies more nearly in the ecliptic. If a substantial part of the zodiacal light is due to dust particles in geocentric orbits, they must be fairly distant, probably beyond about 12 earth radii. Author

N67-23109# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
A PREDICTOR DISPLAY FOR ORBITAL RENDEZVOUS
William K. McCoy, Jr. (Ritchie, Inc.) and George G. Frost Jan. 1967 31 p refs
(AMRL-TR-67-7; AD-645760) CFSTI: HC $3.00/MF $0.65

The study was conducted to investigate the utility of the concept of predictor displays for orbital rendezvous. The display plane was the plane of the orbit (X-Y plane). The display presented the relative position of the target and the interceptor and the predicted path of the interceptor relative to the target. This display was compared with an alternate display identical in all respects except that no predicted path was presented. Eight subjects were used in a counterbalanced transfer of training experimental design. The results indicated that the predictor display significantly improved operator performance of rendezvous as indicated by lower fuel consumption, less variability in fuel consumption and smoother orbital paths. Author (TAB)

N67-23125# Toronto Univ. (Ontario). Inst. for Aerospace Studies
OPTIMIZED PERFORMANCE OF AN ARTICULATED GRAVITY GRADIENT SATELLITE AT SYNCHRONOUS ALTITUDE

P. C. Hughes Nov. 1966 109 p refs
(Grants AF-AFOSR-222-63; AF-AFOSR-222-66)
(UTIAS-118; AD-645164) CFSTI: HC $3.00/MF $0.65

A geometrically and dynamically symmetrical articulated satellite is considered for possible application at synchronous altitudes. The perturbing influence of solar radiation pressure on the two vertical hinged booms is studied, and the small-angle equations of motion derived. From these equations, both the transient and steady-state pointing performance are optimized through a computer search. Pointing errors of the order of two degrees, and damping times less than one orbit are shown to be possible for a weight expenditure of forty-five pounds (satellite payload weight = 250 pounds). Author (TAB)

N67-23157# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
DOUBLY SYMMETRIC ORBITS ABOUT THE COLLINEAR LAGRANGIAN POINTS
T. A. Bray and C. L. Goudas Oct. 1966 48 p refs *Its* Mathematical Note, No. 488
(D1-82-0573; AD-645544) CFSTI: HC $3.00/MF $0.65

The forms and stability of three families of periodic solutions in the three-dimensional case of the Restricted Problem are discussed using the two-point boundary value theory and computing the eigenvalues of the Jacobians of the solutions. It is found that stable members of low inclinations in the case of L2 and L3 indeed exist. The question of a possible new integral in the neighborhood of these points is discussed, together with the equivalent case of galactic motions. It is concluded that a new integral with a single-valued gradient cannot exist unless its gradient is collinear to the gradient of the energy integral along all singular closed solutions. Ordinary solutions, on the other hand, are never found after extensive research by many investigators; and thus the above conclusion seems to be general. Author (TAB)

N67-23259*# Volt Technical Corp., Washington, D. C.
SUCCESS OF LUNA-13. THE MOON IS NOT A DEAD HEAVENLY BODY [SUCCES DE LUNA-13. LA LUNE N'EST PAS UN ASTRE MORT]
Germain Ajoux 13 Feb. 1967 4 p Transl. into ENGLISH from Pourquoi Pas (Brussels), 12 Jan. 1967
(Contract NAS5-12487)
(NASA-CR-83533; ST-PR-LPS-10562) CFSTI: HC $3.00/MF $0.65 CSCL 22A

In performing a study of the lunar soil by radioactivity with Luna-13, Soviet scientists have realized an experiment henceforth classical on Earth, but which constitutes a prominent first in the cosmos. It is generally considered that the data collected by this method will improve considerably the knowledge we now have of the lunar crust. Author

N67-23268* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
OPTIMUM TWO-IMPULSE ORBITAL TRANSFER PROGRAM
G. A. McCue and R. C. Hoy 1 Aug. 1965 69 p refs
(Contract NAS8-5211)
(NASA-CR-83541; SID-65-1119) CFSTI: $3.00 CSCL 22C

A numerical technique to determine optimum two-impulse orbital transfers between inclined elliptical orbits was incorporated into an IBM 7094 Fortran IV program and used to make detailed studies of complicated impulse functions associated with various orbit pairs. An optimum is found by taking trial and error search steps in a direction approximating the negative gradient of the impulse function. The new program is an advance over older methods in that the step size is adjusted automatically to handle scaling and accuracy problems that are encountered when detailed analyses of optima are desired. The Fortran IV program and its subroutines have been documented and a sample problem presented. The adaptive descent program is written in double precision Fortran IV. Depending upon the complexity of the optimum region the program will converge to the minimum impulsive transfer in a few seconds of IBM 7094 time. The program's reliability and versatility has been demonstrated by showing, for example, that two-impulse transfers between certain orbits require less velocity change, by comparison, than a continuous thrust transfer known as the Lawden spiral. Author

N67-23271*# Colorado Univ., Boulder.
AN APPROACH TO THE PROBLEM OF OPTIMIZING ORBITAL MANEUVERS
Adolf Busemann and Robert Dudley Culp Dec. 1966 51 p refs
(Grant NGR-06-003-033)
(NASA-CR-83544) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The general problem of time open maneuvering of an orbital vehicle in a Newtonian gravitational field while conserving the characteristic velocity of the maneuver is considered. The problem is first formulated as a pseudodynamical system in the classical terms of a Hamiltonian. The canonical equations of Hamilton are presented and the maximum principle is applied. The equivalent formulation in terms of the necessary conditions of the calculus of variations is made along with the interpretation of the problem as a search for geodesics, or minimum length paths, in a metric space. This approach considers separately the Weierstrass necessary condition and the Weierstrass–Erdmann corner condition. The approach is applied in detail to the coplanar motion problem; however, the ideas discussed apply to the completely general noncoplanar case. The further requirements of the maximum principle are briefly discussed. The equivalence of the maximum principle and Huygen's wave principle are examined. The complete optimization approach is applied to the coplanar, coaxial case. Author

N67-23291*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MINIMAL ENERGY BALLISTIC TRAJECTORIES FOR MANNED AND UNMANNED MISSIONS TO MERCURY
Larry A. Manning Washington, NASA, Apr. 1967 32 p refs
(NASA-TN-D-3900) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Minimal-energy trajectories are determined for unmanned flybys, unmanned orbiters, and manned stopovers. The velocity requirements for these missions are assessed from consideration of three trajectory modes: direct transfers, unpowered Venus swingby transfers, and modified pericenter Venus swingby transfers. The total and incremental propulsive velocity requirements, the mission durations, and Earth entry velocities, where applicable, are investigated for all missions. The missions have three distinct energy levels. The unmanned flyby mission has a minimum ΔV of 4.2 km/sec, and the unmanned orbiter mission a minimum ΔV of 11.2 km/sec. These requirements are in the same range as those for unmanned Mars probes and manned Mars stopovers, respectively. The manned Mercury stopovers have a minimum ΔV requirement of 18.2 km/sec with a corresponding stay time of 174 days and mission duration of 414 days. Launch windows of 20 days are shown to exist at Earth for penalties of less than 5 percent of the total ΔV. Maximum communication distances of about 1.5 AU are determined by the Earth–Mercury geometry rather than the transfer trajectory mode. Author

N67-23309*# National Aeronautics and Space Administration, Washington, D. C.
CLOSED COLLISION PATHS IN A PLANE CIRCULAR RESTRICTED THREE-BODY PROBLEM [ZAMKNUTYYE TRAYEKTORII SOUDARENIYA V PLOSKOY KRUGOVOY OGRANICHENNOY ZADACHE TREKH TEL]
G. A. Krasinskiy Apr. 1967 20 p refs Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), v. 9, no. 2, 1963 p 154–167
(NASA-TT-F-464) CFSTI: HC $3.00/MF $0.65 CSCL 03C

The paths of double collision with a greater mass in the plane circular restricted three-body problem are studied. The existence of certain types of paths both symmetric and asymmetric with respect to the x-axis is shown by the small-parameter method. The method of constructing these paths is given. Author

N67-23314*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LAUNCH WINDOW CHARACTERISTICS OF THE 1972 AND 1973 JUPITER OPPORTUNITIES

Tim J. Kreiter Washington, NASA, 21 Mar. 1967 32 p ref (NASA-TM-X-52288) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The launch window characteristics of the 1972 and 1973 Jupiter opportunities were examined assuming an SLV-3X/Centaur-S/Burner II launch vehicle. It was found that for a 90° to 115° launch azimuth sector both the direct and indirect ascent launching modes provide launch windows for these opportunities. If the Jupiter encounter were used to provide gravity assist, the probe could meet a secondary mission objective, such as a galactic probe or a close solar probe. Earth injection energies for the 1972 and 1973 Jupiter opportunities can be reduced by increasing trip time, and no other energy saving schemes were uncovered. Author

N67-23335*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

NECESSARY CONDITIONS FOR OPTIMAL LUNAR TRAJECTORIES WITH DISCONTINUOUS STATE VARIABLES AND INTERMEDIATE POINT CONSTRAINTS

J. F. Andrus (Northrop Space Labs.) and W. E. Miner Washington, NASA, Apr. 1967 42 p refs (NASA-TM-X-1353) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The guidance regime for an optimal multi-stage lunar trajectory is derived by applying the mathematics of the calculus of variations as established by Denbow for the generalized problem of Bolza. The steering angle programs for four constant thrust level phases and the times to initiate and terminate the two coast phases are determined in order to place maximum payload into a specified lunar orbit. The problem considered here is to determine an optimal trajectory consisting of six sub-arcs utilizing three vehicle stages on which maximum payload is transported from an exo-atmospheric point near the Earth to a specified lunar orbit. The intermediate point constraints include two points at which stages are separated and mass discontinuities occur, an Earth parking orbit of specified energy and angular momentum magnitude, and four thrust magnitude levels. The Euler–Lagrange equations determine the optimal steering for the thrusting phases and the Denbow transversality equations are used to calculate the discontinuities at the ends of the subarcs. This method is applied here and the equations necessary to solve this problem using a high-speed computer are derived. Author

N67-23383# Paris Observatory, Meudon (France).

REALIZATION OF A RADIO ASTRONOMY EXPERIMENT IN SPACE [REALISATION D'UNE EXPERIENCE DE RADIOASTRONOMIE SPATIALE]

Jacques Lacroix (Ph.D. Thesis—Paris Univ.) 19 Dec. 1966 241 p refs In FRENCH CFSTI: HC $3.00/MF $0.65

The space experiment proposed by the Meudon Observatory is to measure very low radio frequencies at 1.8 and 2.4 Mhz and the exact electrical characteristics of the antenna. The realization of the experiment and the antennas are described, including tests with a 2-state Rubis sounding rocket launched from Hammaguir. ESRO

N67-23412# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

LUNAR EXPLORATION AND SURVIVAL

Jack Green Jun. 1966 141 p refs /its DARL Res. Communication No. 8 (Douglas Paper-4038)

The major theories of lunar surface origin are examined in the light of recent probe data as related to exploration and survival problems in the post-Apollo period. Evidence from Ranger, Luna, and Mariner probes is analyzed in an attempt to answer the question of whether the lunar surface features are the result of volcanic processes or meteoritic impacts. The analysis is related to the practical question of lunar survival because the exploration and survival advantages of a volcanic terrain are superior to those of an impacted one. Consideration is given to initial landing problems, lunar water resources, other potential lunar resources, altitude studies, and location of a lunar base. A.G.O.

N67-23425# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON THE SCATTERING OF LIGHT IN PLANETARY ATMOSPHERES. ON THE PROBLEM OF DIFFUSE REFLECTION OF LIGHT BY A TURBID MEDIUM

V. A. Ambartsumyan [1966] 36 p refs Transl. into ENGLISH from Russian /its Astron. Papers Translated from the Russian, No. 7

The problems of scattering of light in planetary atmospheres and diffuse reflection of light by a turbid medium are considered. An integral equation from scattering theory for the case of spherical indicatrix is given, and its solution reduces the problem to a functional equation that is easy to solve numerically. Results obtained are used to determine the distribution of intensity over the disk of a planet at different phases. A particularly simple result is obtained for the case when the planet is in opposition. From the auxiliary functions introduced the plane albedo of the medium, i.e., the ratio of the flux scattered by the medium to that incident on it, is determined. The problem of diffuse reflection of light by a medium which both scatters and absorbs light is solved with a new method that leads to a linear integral equation. This method does not resort to the calculation of quantities which characterize the behavior of light within the medium, and it allows confinement to an analysis of the conditions at the boundary. S.P.

N67-23426# Smithsonian Astrophysical Observatory, Cambridge, Mass.

OPTICAL PROPERTIES OF THICK LAYERS OF A HOMOGENEOUS SCATTERING MEDIUM

G. V. Rozenberg [1966] 58 p refs Transl. into ENGLISH from the book "Spektroskopiya Svetorasseivayushchikh Sred" Minsk, Izd. Akad. Nauk BSSR, 1963 p 5–36 /its Astron. Papers Translated from the Russian, No. 9

The diffusion of light in an isotropic scattering nonemitting medium is considered and described by a matrix integro-differential equation of transfer. Machine and approximate methods of solution of the equation of transfer are compared and the results are extended to a wider range of experimental situations. First equations are presented for the deep light regime whose character depends not on boundary conditions but on the properties of the medium itself. Then a layer of finite optical thickness illuminated quasidiffusely from one side is considered. The case of reflection from a semi-infinite layer and the mean number of scatterings is presented. Finally, the influence of an underlying surface is supposed. The relations obtained allow solution of applied problems in fields of light technology and geophysics; and also production requirements of the lacquer, paint, paper, printing, and textile industries. The solutions relate exclusively to monochromatic radiation. S.P.

N67-23439#

SATELLITE MEASUREMENTS OF PARTICLES CAUSING ZODIACAL LIGHT

Jose M. Alvarez [1967] 21 p refs Presented at Intern. Symp. on the Zodiacal Light and the Interplanetary Medium, Honolulu, Hawaii, 30 Jan.–3 Feb. 1967

An analysis of Pegasus and Explorer data on particles causing Zodiacal light is presented, and an equation is developed for penetration rate in terms of material thickness. Hypervelocity impact theory is then used to interpret the penetration rate data in terms of particle concentration and particle radii. The apparent inconsistency in penetration data is due to differences in detector materials and physical differences in the detection process employed by the two satellite series. The Pegasus spacecraft used aluminum capacitor-type penetration detectors and the Explorers used stainless steel and beryllium copper pressurized cell-type penetration detectors. Penetration equations used to obtain the possible range of particle sizes that penetrated the satellite detectors are tabulated; and the extremes of the concentration obtained by using the highest and lowest penetration depth to particle radius ratios are presented. S.P.

N67-23443# Georgetown Univ., Washington, D. C. Coll. Observatory.

AN INVESTIGATION OF THE MAGNETIC AND RELATED STARS THROUGH PHOTOELECTRIC NARROW-BAND PHOTOMETRY

Robert C. Cameron (Ph.D. Thesis) Sep. 1966 143 p refs Revised *Its* Monograph No. 21

CFSTI: HC $3.00/MF $0.65

Three hundred peculiar A stars (Ap stars), exhibiting enhanced spectral lines of certain elements, and 100 metallic-line A stars (Am stars), exhibiting general enhancement of the metallic spectrum, were observed photoelectrically with the 16-inch reflector. The great majority of the 93 known magnetic stars and 66 suspected magnetic stars (displaying Zeeman splitting of the spectral lines) are of the Ap or Am types, and are necessarily sharp-lined for detection of the Zeeman effect. The principal program stars included, in addition to the magnetic stars, Ap and Am stars with relatively broad spectral lines and also others which have never been examined for the Zeeman effect. Additional normal comparison stars and stars with unusual characteristics were observed also. The total number of stars observed was 749. Bearing on the basic question of the origin and evolution of stellar magnetic fields, evidence is presented suggesting that the strongest-field magnetic Ap stars are the slowest rotators for their surface temperatures, and favoring the (slowly rotating) oblique-rotator model of the Ap stars, rather than that of the rapidly rotating star seen pole-on. Author

N67-23461# Royal Aircraft Establishment, Farnborough (England).

THE FIRST LANDING ON THE MOON, BY LUNA 9

20 Apr. 1966 37 p Transl. into ENGLISH from Russian (RAE-LIB-TRANS-96) CFSTI: HC $3.00/MF $0.65

The flight and soft landing of Luna 9 on the surface of the moon is reported. The spacecraft is described and the braking phase, the actual landing, and the communication sessions are covered. C.L.W.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-22071*# National Aeronautics and Space Administration, Washington, D. C.

THIRD SURVEYOR LAUNCH SLATED AT CAPE KENNEDY

14 Apr. 1967 48 p

(NASA News Release-67-85) Available from the Scientific and Technical Information Division CSCL 22B

A journalistic account is given of the Surveyor C, which will provide scientific and engineering data to support the Apollo manned landing program by photography and other on-board instrumentation. The spacecraft design is described, and consideration is given to the Atlas–Centaur launch vehicle, Atlas–Centaur launch sequence, tracking and communication, trajectory, and flight plan. L.E.W.

N67-22078*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AN EVALUATION OF AN OPERATIONAL SOUNDING ROCKET TO FULFILL A NEW 100 KILOMETER REQUIREMENT

Mark B. Nolan and Edward E. Mayo Mar. 1967 19 p refs

(NASA-TM-X-55738; X-721-67-144) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The payload-apogee altitude performance, static stability, and dynamic motions of the Tomahawk vehicle (second stage of the Nike–Tomahawk system) are analyzed with respect to its ability to meet a new requirement for a 100-kilometer sounding rocket. The vehicle has the impulse to lift the required payload to the required altitude and the payload can be increased by replacing the standard nose cone (3:1 ogive) with a lower drag configuration. The single-stage vehicle is very drag-sensitive, losing 4000 feet in apogee for each 1-percent increase in drag. The fins produce adequate stability to fly payloads as light at 65 pounds for the 3:1 ogive nose. The optimum fin cant from a flight dynamics standpoint was determined to be 35 minutes, with a resulting peak roll rate of 10 cps. If required by the experiment, the peak roll rate can be reduced to 6.5 cps while the resulting rolling trim remains less than 5 degrees. The vehicle asymmetries evaluated were the maximum manufacturing tolerances and were oriented to give maximum degradation to roll rate at resonance. Author

N67-22077*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

NOSE SELECTION AND VEHICLE MOTION DYNAMICS FOR THE SECOND STAGE OF A TWO-STAGE SOUNDING ROCKET SYSTEM

Edward E. Mayo and Mark B. Nolan Mar. 1967 16 p refs

(NASA-TM-X-55739; X-721-67-145) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Simple procedures are applied to the Nike–Tomahawk to arrive at an optimum nose shape. The effects of nose shapes on altitude performance, overall vehicle stability, and bending moments about the payload-rocket interface are discussed. The vehicle stability and undamped pitch frequencies are examined. A six-degree-of-freedom study is made of the vehicle dynamics at booster separation, at resonance, and after burnout. A comparison of Nicolaides' equilibrium solutions with vehicle dynamics at booster separation and at resonance shows that the solutions adequately predict the rolling trim. The vehicular motion constraints, level of aerodynamic pitch damping, and axial force contributions to the rolling trim at resonance are presented. The effects of payload weight, fin cant, fin misalignment, thrust misalignment and eccentricity, and level of aerodynamic pitch damping are investigated. The allowable center-of-gravity offset to ensure a break-out of roll lock-in was estimated by equilibrium equations and verified by dynamic simulation on digital computer. Author

N67-22158*# General Dynamics/Fort Worth, Tex. Operations Research Section.

SPACE STATION MISSION SIMULATION MATHEMATICAL MODEL Summary Report

27 Mar. 1967 26 p refs
(Contract NAS1-5874)
(NASA-CR-66316; FZM-4779, Vol. I) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A brief description of the basic modelling objectives, analyses performed during model development, and a synopsis of applications to which the model is suited are presented. The computerized, mathematical model is to serve as an analytical, managerial tool for efficient implementation of a MORL system or other programs. It is pointed out that the model enables the analyst to perform a spectrum of integrated studies, and typical case studies are given. Summaries are included of the following areas: model concept; crew, experiment, and logistics analyses; event scheduling; station operations; probabilistic event simulation; and mission evaluation. N.E.N.

N67-22160*# General Dynamics/Fort Worth, Tex. Operations Research Section.
SPACE STATION MISSION SIMULATION MATHEMATICAL MODEL
6 Feb. 1967 318 p refs
(Contract NAS1-5874)
(NASA-CR-66316; FZM-4770, Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A detailed technical discussion of a space station mission simulation mathematical model study is presented. Results of a previous analysis which formed the basis of the model structure, as well as a description of the model and its applications, are included. The model which consists of three computer procedures, is in general suited to problems involving the effectiveness of a medium-sized earth orbital space station. The first procedure provides a means for examining space station problems on a broad, gross basis. The second procedure can be used to establish a mission plan similar to that which would be made prior to an actual mission. The third procedure enables detailed simulations of space station missions. C.T.C.

N67-22395# Geophysics Corp. of America, Bedford, Mass. Technology Div.
ROCKET PAYLOADS Final Report, 1 Aug. 1965–31 Jul. 1966
John R. Campos Sep. 1966 25 p
(Contract AF 19(628)-5555)
(GCA-TR-66-8-A; AFCRL-66-690; AD-643541) CFSTI: HC $3.00/MF $0.65

Payloads consisting of TMA and sodium were constructed and one was flown from the Elgin Test Range in Florida. Two 70-mm cameras suitable for twilight and night trail photography were designed and developed along with an adjustable camera mount for pointing in azimuth and elevation and a timing console for sequentive automatic exposures. Refinements of existing procedures for obtaining estimated wind velocity data led to the development of photographic projection technique, which can be programmed for use with a computer. Author (TAB)

N67-22486# McGill Univ., Montreal (Quebec). Space Research Inst.
ORBITAL AND HIGH ALTITUDE PROBING POTENTIAL OF GUN LAUNCHED ROCKETS
G. V. Bull, D. Lyster, and G. V. Parkinson Oct. 1966 60 p refs
(R-SRI-H-R-13) CFSTI: HC $3.00/MF $0.65

Consideration is given to the current and projected status of HARP vehicles with respect to high altitude probing, earth orbit performance, re-entry studies, and long range capabilities. Reference is made to the various Martlet vehicles and their role in the many aspects of the project. Gun performance and vehicle performance, in the form of both actual and computed results, are included to give a compact presentation of current and future program status. Author

N67-22497# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Div.
SATELLITE TRANSITS RECORDED AT EARLYBURN, OCTOBER TO DECEMBER 1965
Bennet McInnes 29 Sep. 1966 4 p
(Rept.-55) CFSTI: HC $3.00/MF $0.65

Artificial satellite transits were recorded at Earlyburn, and statistics of observations were made for the observing season 1965–1966 by satellites in launch order. The present list gives 131 transits filmed in November and December 1965 and for each satellite the cinetheodolite observations are mentioned in chronological order. ESRO

N67-22499# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Div.
SATELLITE TRANSITS RECORDED AT EARLYBURN, JANUARY TO MARCH 1966
Bennet Mc Innes 9 Dec. 1966 8 p
(Rept.-60) CFSTI: HC $3.00/MF $0.65

Artificial satellite transits were recorded at Earlyburn, and statistics of observations were made for the observing season (January to March 1966) by satellites in launch order. A total of 360 transits concerning 81 different satellites were filmed. ESRO

N67-22589# Library of Congress, Washington, D. C. Aerospace Technology Div.
LUNA-10 REPORTAGE FROM THE VICINITY OF THE MOON
Boris Doncov *In its* Foreign Sci. Bull., Vol. 2, No. 12 Dec. 1966 p 16–23 refs (See N67-22587 11-34) CFSTI: HC $3.00/MF $0.65

Preliminary data and results are presented on the experiments conducted by Luna 10. The satellite carried five particle counters, four particle traps, several impact sensors, and one magnetometer. Measurement equipment specifications are given. Data are plotted for the radiation count as a function of distance from the moon's surface; the Luna 10 location and magnetosphere tail boundary; and the number of solid particle impacts as a function of the distance from the moon. It was concluded: (1) The moon's magnetic field intensity is greater than that of interplanetary space; it is surmised that the lunar crust, which exhibits finite conductivity and magnetic permeability, affects the interplanetary field. (2) Results indicate that the magnetosphere tail extends 380,000 km into space. This is evident from the simultaneous count rate variations whenever the magnetosphere boundary was crossed. (3) The intensity of the magnetic field in the magnetosphere tail is considered to be under five gamma. M.G.J.

N67-22613# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ORBITAL RESULTS FROM GRAVITY-GRADIENT STABILIZED SATELLITES
Frederick F. Mobley and Robert E. Fischell Oct. 1966 53 p refs
(Contract NOw-62-0604-c)
(TG-826; AD-645721) CFSTI: HC $3.00/MF $0.65

The possibility of using the earths gravity field for vertical stabilization of near-earth satellites has intrigued theoreticians for many years. The very small stabilizing torque available and the lack of a natural damping mechanism have been recognized as the major problems. The satellite 1963-22A, launched in June 1963, was the first orbiting vehicle to achieve passive gravity-gradient stabilization. A 100-foot extendible boom was used to develop gravity-gradient stabilizing torque. A combination of a lossy spring and magnetic hysteresis rods provided damping. By June 1964 four other satellites had achieved gravity-gradient stabilization. The satellite 1964-28A was similar to 1963-22A except that good

damping was achieved with magnetic hysteresis rods alone. The discovery that several slender rods of magnetic material, weighing only 0.6 pounds and entirely passive, would damp gravity-gradient librations by interaction with the earths magnetic field was a major advance in space technology. The accuracy of vertical stabilization has typically been better than 10 degrees. Author (TAB)

N67-22868*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PILOTED SIMULATION STUDY OF MANUAL GUIDANCE OF THE UPPER STAGES OF A LARGE LAUNCH VEHICLE
Richard L. Kurkowski, Gordon H. Hardy, and Glen D. Ritter (NASA, Marshall Space Flight Center) Washington, NASA, Apr. 1967 42 p refs
(NASA-TN-D-3901) CFSTI: HC$3.00/MF$0.65 CSCL 22B

The feasibility of manually guiding the upper stages of a large launch vehicle by means of a minimum of on-board equipment has been investigated. A fixed cockpit analog simulation of the rigid body dynamics of the upper stages of the Saturn V (S-II and S-IVB) lunar mission vehicle was used. Five guidance schemes were studied and the results indicate that with manual guidance of the vehicle into earth orbit the injection errors can be less than ±1000 m in altitude, ±3 m/s in velocity, and ±0.1° in flight-path angle. Author

N67-22886* National Aeronautics and Space Administration, Washington, D. C.
PROJECT SAN MARCO-B
17 Apr. 1967 20 p
(NASA News Release-67-93) Available from the Scientific and Technical Information Division CSCL 22B

A journalistic review is given of the Italian satellite, which is the first satellite scheduled to be launched into orbit from a platform at sea. The primary objective is stated to be the gathering of continuous equatorial air density measurements by monitoring the drag forces on the spacecraft. The air drag forces are measured by a payload configuration consisting of a heavy spherical structure contained in a much lighter spherical outer shell. Background material is presented on the experiments, launch platform, satellite, instrumentation and communication systems, command and data acquisition, tracking, and Scout launch vehicle. N.E.N.

N67-22887*# LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.
FEASIBILITY STUDY OF STORAGE CONCEPTS FOR SCOUT AND OTHER NASA SOLID PROPELLANT LAUNCH VEHICLES
R. D. Fielder and H. N. Nesbitt Washington, NASA, Apr. 1967 153 p refs
(Contract NAS1-6748)
(NASA-CR-66321) CFSTI: HC$3.00/MF$0.65 CSCL 22D

A systematic study was performed to determine the feasibility of storing launch vehicles in an assembled and flightworthy configuration for long periods of time. The study concludes that long term storage for Scout is feasible where the aggregate storage time encompasses disassembled, assembled and ready-hold levels of storage; and that the other solid propellant launch vehicles are compatible with the Scout storage concept. The study is divided into three tasks. Task I encompasses the storage concepts for the Scout vehicle and an evaluation of the cost involved to implement each concept. Task II encompasses the effect the storage concept has on the Scout vehicle components, assemblies, and systems; and the problems associated with flight-ready storage and storage surveillance. Task III is an examination of the other solid propellant launch vehicles for applicability to the Scout storage concept. The recommended concept is a fixed container consisting of an environmentally controlled prefabricated steel building with steel frame supports onto which the vehicles are roll transferred for storage. Author

N67-22944# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET AA-III-11 LAUNCHED AT CHURCHILL RESEARCH RANGE 21 APRIL 1965
Oct. 1966 38 p
(SRFB-001) CFSTI: HC$3.00/MF$0.65

The engineering aspects of preparing the payload and the launching of Black Brant rocket AA-III-11 at the Churchill Research Range on 21 April 1965 are described. The payload included a cosmic ray experiment to measure pitch angle distribution and the energy spectrum of electrons associated with an auroral event. A plasma probe using an insulated nose tip measured electron density and electron temperature. Author

N67-23263* National Aeronautics and Space Administration, Washington, D. C.
APOLLO APPLICATIONS BRIEFING
26 Jan. 1967 69 p
Available from the Scientific and Technical Information Division CSCL 22B

An overview is presented of the aims and objectives of the Apollo Applications Program whose purpose it is to serve two basic functions: (1) to make contributions to practical applications, operational capabilities, science, and technology and (2) to provide the experimentation and experience necessary to assess the value and feasibility of future space flight and the interrelated roles of manned and unmanned systems. Details are given on the funding aspects, including distribution and basis of fund requirements. The text of the news briefing is also included. L.E.W.

N67-23281*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
DYNAMIC MODEL INVESTIGATION OF THE ROUGH-WATER LANDING CHARACTERISTICS OF A SPACECRAFT
William C. Thompson Washington, NASA, Apr. 1967 25 p refs
(NASA-TN-D-3774) CFSTI: HC$3.00/MF$0.65 CSCL 22B

The investigation was made to study the landing characteristics of a Gemini type of spacecraft. The investigations were made with a 1/6-scale dynamic model in a simulated sea state 4 rough water. Parachute letdown landings were simulated with the model at various yaw angles and horizontal velocities. The vertical velocity and landing attitude remained constant. The range of maximum lateral and longitudinal acceleration was from about 3-1/2g to 16g while that for the maximum normal acceleration was from 1g to 15g. The range of maximum angular acceleration was from about 0 to 190 radians per second^2. The smoothest behavior and the lowest angular acceleration occurred at the 90° yaw angle. The normal acceleration was near minimum at this condition. Author

N67-23282*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
WATER-LANDING CHARACTERISTICS OF A 1/10-SCALE MODEL OF A WINGLED MISSILE
Lloyd J. Fisher and John O. Windham Washington, NASA, Apr. 1967 27 p refs
(NASA-TN-D-3799) CFSTI: HC$3.00/MF$0.65 CSCL 16D

An investigation was made of a winged missile model to study its behavior when landed in the bare-fuselage condition in water and when landed with a hydroski landing gear. Various landing attitudes, speeds, and configurations (ski and fuselage) were investigated. The behavior of the model was determined from visual observations and motion-picture records of the landings. Data are presented in tables and sequence photographs. The bare-fuselage landing behavior was extremely violent. The vehicle decelerated rapidly in a nose-down (nose-in-water) attitude, skipped, and turned either to the left or right near the end of a landing run. The severity of the behavior was such that the fuselage bottom would probably sustain appreciable damage—thus, rapid

flooding and short flotation time are likely. The length of the landing run for a vehicle with a damaged bottom would be about 500 feet (150 meters). The hydroski landings also resulted in violent or inconsistent behavior at all test conditions except when the skis were located well forward of the center of gravity and set at a high angle of incidence. Relatively large hydroskis were also required. In this case, the vehicle trimmed down, skipped slightly several times, and then ended the landing in a fairly smooth planing run of about 2000 to 3000 feet (600 to 900 meters). The fuselage bottom would probably sustain less damage with hydroskis than in the unprotected bare-fuselage condition, and the flotation time should be increased. Author

N67-23293*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT-TEST EVALUATION OF AN ON-OFF RATE COMMAND ATTITUDE CONTROL SYSTEM OF A MANNED LUNAR-LANDING RESEARCH VEHICLE

Calvin R. Jarvis Washington, NASA, Apr. 1967 39 p refs
(NASA-TN-D-3903) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The control characteristics of a free-flight lunar landing research vehicle (LLRV) which uses a fly-by-wire on-off rate command attitude control system were investigated. Results of a flight test program and fixed-base simulator studies show that the rate command control boundary associated with vehicle attitude control in a lunar gravity environment can be expanded from that experienced in conventional VTOL operation to include less damping, lower control authorities, and higher controller sensitivities. Satisfactory LLRV attitude control was attained at pitch and roll control authorities as low as 5 deg/sec^2 and 7.5 deg/sec^2, respectively. Flight experience showed that disturbing moments and low values of control authority could result in pilot-induced instabilities about the pitch and roll axes as a result of the control-logic arrangement of the LLRV. For this reason, the degree to which the maximum disturbing moments could be controlled was the limiting factor in establishing the minimum level of control authority for satisfactory operation. The large vehicle attitudes and long lead times required for translation maneuvers in the lunar simulation mode were initially distracting to pilots. Pilots accepted higher controller sensitivites for lunar simulation operation than for conventional VTOL operation. Author

N67-23318*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN ANALYSIS OF RESULTS OF THERMAL-VACUUM TESTS ON OGO EXPERIMENTS

Nancy E. Lucas and Albert R. Timmins Feb. 1967 45 p refs
(NASA-TM-X-55748; X-326-67-75) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Simulated space tests conducted on experiments for the Orbiting Geophysical Observatory have been reviewed and analyzed. The 374 tests were examined and summarized for the effects of test time, thermal level, sequence, phase, year of test, program, experimenter, and model on the numbers and time distribution of failures. Graphs are presented to show the number of malfunctions with relationships to the duration of the test, together with the influence of prototype and flight models and thermal levels. Author

N67-23336*# National Aeronautics and Space Administration, Washington, D. C.

SPACE: THE NEW FRONTIER

[1966] 98 p
GPO: HC $0.75; CFSTI: MF $0.65 CSCL 22B

This illustrated educational booklet contains general information and data on the following subjects: (1) space and history of space flight; (2) the solar system; (3) principles of space probes and satellites; (4) sounding rockets, scientific satellites, and applications satellites; (5) unmanned lunar and interplanetary spacecraft; (6) manned space exploration; (7) space launch vehicles; (8) biological considerations in space exploration; (9) astronaut selection and training; (10) rocket propulsion principles and techniques; and (11) electric power generation, guidance, and communications. Supporting research is also briefly discussed. K.W.

N67-23337*# National Aeronautics and Space Administration, Washington, D. C.

THIRD UK SATELLITE LAUNCH SET

27 Apr. 1967 15 p refs
(NASA News Release-67-96) Available from the Scientific and Technical Information Division CSCL 22B

This press kit contains technical details on the third United Kingdom satellite launching from the Western Test Range, Lompoc, California. On attaining orbit the UK-E satellite becomes known as Ariel III. The 198-pound spacecraft was scheduled to be placed in an approximately 342-mile, circular polar orbit by a four-stage Scout rocket. Included is background information on various scientific experiments, the spacecraft, and subsystems. Communications systems reported are: tracking and data acquisition, telemetry, high-speed encoder, low-speed encoder, data storage, and the command receiver. R.U.

N67-23344*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

STATIC AERODYNAMIC CHARACTERISTICS OF THE ABORTED APOLLO–SATURN V VEHICLE

Robert M. Glasgow 9 Mar. 1967 108 p refs
(NASA-TM-X-53587) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Presented are the static aerodynamic characteristics of the aborted Apollo–Saturn V vehicle. The data are based primarily on wind tunnel tests of scale models. Total normal and axial force characteristics with local normal, local axial, and local pressure force distributions necessary for performance, control, and basic structural analyses of the vehicle are presented. All results are presented for various Mach numbers between 0 and 3.0 and vehicle angle-of-attack variations between 0 and 16 degrees. Author

N67-23458# Joint Publications Research Service, Washington, D. C.

THE COSMOS SATELLITES IN NEAR-EARTH ORBITS

Yu. Zaytsev 1 Feb. 1967 13 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 12, Dec. 1966 p 62–67
(JPRS-39730; TT-67-30378) CFSTI: HC $3.00/MF $0.65

The Cosmos satellites were used as the instrumental and vehicle background in assessments of the importance and contributions of satellite vehicles to scientific study. This importance was viewed in terms of the knowledge generated which has allowed technology to advance, manifesting itself in the increasingly reliable design of spacecraft. These contributions were further emphasized in citing them as being responsible for an increasing awareness of the dangers of the space environment, through investigations of the hazards of ionizing radiation and exploration of the earth radiation belts. The discovery of additional information on cosmic rays, studies of the ionosphere and atmosphere, and the contributions to biology and medicine from prolonged space flight are also cited. C.L.W.

N67-23480*# National Aeronautics and Space Administration, Washington, D. C.

ROCKET-SONDE

Homer E. Newell 28 Feb. 1967 22 p refs Presented at AIAA Sounding Rocket Vehicle Technol. Specialist Conf., Williamsburg, Va., 28 Feb. 1967
Available from the Scientific and Technical Information Division CSCL 22D

The conception and development of the sounding rocket as a means for conducting research in the upper atmosphere is assessed in a nondetailed manner. The assessment covers areas such as, the early years of rapid learning, the beginning of the research period with the launching of a WAC Corporal from the White Sands Missile Range in New Mexico in March 1945, the falling sphere program at Fort Churchill, the utilization of the V-2 rocket, and the development and use of the complex instrumentation and vehicles of the present. C.L.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-22058*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THERMAL STRESSES IN CELLULAR CONCRETES DURING HYDROTHERMAL PROCESSING

A. I. Avakov, K. E. Garyainov, and L. T. Yakovlev *In its* Non-Stationary Heat and Mass Transfer, 1967 p 115–120 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Analytical methods were used to derive equations for the calculation of temperature changes and the associated thermal stresses. In order to compare the analytical solutions obtained with experimental data, calculations were carried out on a plate made of cellular concrete. Formulas are presented for the change of temperature for heating and cooling, and the magnitude of the stresses was calculated by the reduced Gatewood equation for fairly distant points in an isotropic elastic body. An analysis of the equations for the heating period of the plate indicated that the stresses depend on the thermal and mechanical properties of the material, rate of temperature change, geometric dimensions, nature of the heat exchange with the surface, and time. It was concluded that during the heating of cellular concretes their elasticity modulus and thermal stresses are smaller than during cooling. In the cooling periods, after completion of the chemical reactions in the concrete, the elasticity modulus increases markedly and the thermal stresses are higher than in the heating stage. L.E.W.

N67-22059*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE ITERATION METHOD OF SOLVING THE PLANE ELASTIC-PLASTIC PROBLEM OF SOIL MECHANICS

E. F. Vinokurov *In its* Non-Stationary Heat and Mass Transfer 1967 p 121–125 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

The application of the elasticity theory to soil mechanics is discussed, and the Lame-type equations that characterize the elastic–plastic deformation of soils are given. A first approximation method based on existing solutions is proposed. To determine the displacement, the calculation scheme is presented as a lattice-like region, and the displacement of points on the edge is represented by means of the displacement of internal points adjacent to the edge and by the boundary conditions. A simplified technique is suggested whereby the displacement of the lattice can be calculated, using the general theory of bodies subjected to linear deformation. L.E.W.

N67-22062*# Philco Corp., Palo Alto, Calif. Western Development Labs.

STRUCTURAL ANALYSIS AND MATRIX INTERPRETIVE SYSTEM (SAMIS) PROGRAM REPORT Technical Memorandum, Feb. 1963–Dec. 1966

Robert J. Melosh, Philip A. Diether, and Mary Brennan 15 Dec. 1966 210 p refs Prepared for JPL Revision I
(Contracts NAS7-100; JPL-950321)
(NASA-CR-83270; JPL-TM-33-307) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The computer aspects of the structural analysis and matrix interpretive system (SAMIS) are described. A general description of system components and their function, operations, flow, and program intelligence are included. Data and program identification, formats, and handling are described. System tape and core assignments are defined. Writeups of each of the subprograms and requirements for preparing input data are also presented. Author

N67-22063*# Philco Corp., Palo Alto, Calif. Western Development Labs.

STRUCTURAL ANALYSIS AND MATRIX INTERPRETIVE SYSTEM (SAMIS) PROGRAM Technical Report, Feb.–Aug. 1966

Robert J. Melosh and Henry N. Christiansen 1 Nov. 1966 140 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950321)
(NASA-CR-83269; JPL-TM-33-311) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The technical basis for programs contained in the structural analysis and matrix interpretive system is described. The stiffness, stress, loading, and transformation relations for representation of a structure by a collection of flat triangular shell facets, rods, beams, and tubes are developed. The basis for special and complex program links is defined, the use of these programs for structural analysis is discussed. A discourse on analysis error in formulating the mathematical model of a structure and in analyzing it is presented. Author

N67-22068*# Drexel Inst. of Tech., Philadelphia, Pa.

ANALYTICAL STUDY OF THE FRACTURE OF LIQUID-FILLED TANKS IMPACTED BY HYPERVELOCITY PARTICLES

Pei Chi Chou, Richard Schaller, and James Hoburg Mar. 1967 74 p refs
(Grant NsG-270)
(NASA-CR-72169; DIT-160-9) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A semi-empirical formula is used for the shock wave generated by impact in water. The numerical method of characteristics is adopted for the calculation of stress waves in the tank wall. Values of threshold impact kinetic energy, defined as the projectile energy above which fracture will occur, for a few wall thickness and materials are determined. Author

N67-22152* IIT Research Inst., Chicago, Ill.

PASSIVE GEODETIC SATELLITE INFLATION RATE STUDY

Ernesto Saleme Washington, NASA, Apr. 1967 124 p refs
(Contract NAS1-5278)
(NASA-CR-746) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The mechanics of the inflation process of a spherical balloon orbiting at high altitude is presented. Mathematical models suitable for the two basic stages of the process (deployment and inflation) are developed, and numerical solutions using high speed digital computers are presented. A method is also established for determining the stresses developed in the skin during the inflation process. The elasticity of the transverse (accordion) folds is analyzed by means of an equivalent spring, and that of the meridian pleats by using the large deformation theory of beams. The conditions (modeling laws) that a model test must satisfy in order to accurately describe the behavior of the prototype are established. The effects of lack of compliance with these modeling laws are discussed. Computer programs for the solution of the two stages of the process and several numerical examples are included. Author

N67-22180*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

AUTOMATED NOSE FAIRING DESIGN—RING AND SKIN CONSTRUCTION

A. B. Burns et al Nov. 1965 184 p refs

(Contract NAS8-15485)

(NASA-CR-83318; HREC/5485-1; LMSC/HREC-A712552) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The computer program described in this report determines the optimum design for ring-stiffened sheet metal nose fairings with an external geometry consisting of up to ten intersecting conical frustums (or cylinders) capped with a spherical nose cap. The combined effects of bending moments, axial loading due to drag, and lateral pressure are considered in performing the design. Only standard gauge materials are used in the design of the shell and rings. Because of the difficulty of applying the more powerful mathematical techniques to optimizing such a design, the designer is limited to time-consuming cut-and-try procedures in his search for the minimum weight design. These procedures have been methodically arranged and mechanized in the Fortran IV computer program described in this report. The main part of the report is devoted to description of the logic followed in designing a fairing, description of the computer program, and instructions on operation of the program. The program listing and details of the methods of analysis used in design of fairing appear in the appendixes. Author

N67-22258*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

AUTOMATED NOSE FAIRING DESIGN RING, SKIN AND STRINGER CONSTRUCTION Technical Report, Jul.–Nov. 1965

E. S. Hendrix and A. B. Burns Dec. 1965 153 p refs Supersedes LMSC/HREC-A711099

(Contract NAS8-15485)

(NASA-CR-83566; LMSC/HREC-A712572; LMSC/HREC-A711099) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The computer program described in this report synthesizes near-optimum designs for ring, skin, and stringer nose fairings with an external geometry consisting of up to ten intersecting conical frustums (or cylinders) capped with a spherical nose cap. The combined effects of bending moments, axial loading due to drag, and lateral pressure are considered in performing the design. Only standard gauge materials are used in the design of the skin, stringers, and rings. Because of the difficulty of applying the more powerful mathematical techniques to optimizing such a design, time-consuming "cut-and-try" procedures for determining minimum weight design were methodically arranged and mechanized in a Fortran IV computer program. The logic followed in designing a fairing, description of the computer program, operational instructions of the program, the program listing, and details of analysis methods for the fairing design are included. Author

N67-22399# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

THE APPLICATION OF THE SMOOTH-SURFACE INTERPOLATION TECHNIQUE TO THE FINITE-ELEMENT ANALYSIS OF THIN PLATES

Alexander L. Deak and Theodore H. H. Pian Aug. 1966 56 p refs

(Grants AF-AFOSR-347-64; AF-AFOSR-347-65)

(ASRL-TR-136-2; AFOSR-66-2044; AD-643870) CFSTI: HC $3.00/MF $0.65

The report introduces two new developments concerning the finite-element displacement method for analysis of plate bending. Both are restricted to plates which are subdivided to rectangular meshes. The first analysis makes use of the twelve degrees of freedom stiffness and mass matrices which are derived based on the fully compatible smooth-surface interpolation functions developed recently by Birkhoff and Garabedian. The second development is a modified displacement method which through the spline-interpolation procedure reduces the order of the associated matrices by eliminating the first derivatives at the nodes as generalized coordinates. Numerical results are included for both static and free vibration problems. Author (TAB)

N67-22586# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.

HYDROSTATIC PRESSURE TESTS OF GLASS-REINFORCED-PLASTIC SANDWICH CYLINDERS WITH LIGHTWEIGHT FOAM CORE

Gerald D. Ward and Kenneth Hom Dec. 1966 38 p refs

(DTMB-2291; AD-646029) CFSTI: HC $3.00/MF $0.65

Six sandwich cylinders consisting of filament-wound, glass-reinforced-plastic (GRP) faces and a uniform core of syntactic foam were tested under external hydrostatic pressure to investigate stiffening systems for shear-sensitive materials. The cylinders were designed for a collapse depth of 12,000 to 40,000 feet. Maximum stress developed in the GRP facings prior to failure exceeded 150,000 psi. Stress levels of this magnitude have never been realized with ring-stiffened cylinders fabricated from glass reinforced plastics. Only a marginal increase in static-strength performance was realized because the syntactic foam was relatively heavy in comparison to its compressive strength. However, a higher cyclic performance might be realized. TAB

N67-22618# Cambridge Acoustical Associates, Inc., Mass.

AN APPROXIMATE METHOD FOR ANALYZING THE VIBRATIONS OF STIFFENED PLATES AND SHELLS Final Report

Thomas L. Geers Nov. 1966 216 p refs

(Contract NObs-90438)

(U-238-165; AD-646353) CFSTI: HC $3.00/MF $0.65

The report develops an approximate method for analyzing the vibrations of plates and shells which are stiffened by parallel stiffeners running in one direction. The method involves the application of two distinct approximation techniques. The first consists of relating the stiffened structure to an equivalent orthotropic structure of uniform thickness by, at most, five non-dimensional parameters; these parameters are related to the effective moduli of elasticity, the effective radii of gyration and the average mass per unit area appropriate to the stiffened structure. The second technique is applied when a given vibration pattern, (i. e. a given set of eigenfunctions), possesses more than one mode of vibration; it consists of applying to the stiffened structure certain modal approximations which have first been used successfully in analysing the virbrations of the corresponding uniform isotropic structure. The method is applied to the vibrations of a thin stiffened rectangular plate, a thick stiffened rectangular plate, and a thin ring-stiffened circular cylindrical shell. Author (TAB)

N67-22639# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.

ELASTIC STRESS ANALYSIS IN THE END BAYS OF STIFFENED CIRCULAR CYLINDRICAL SHELLS UNDER EXTERNAL HYDROSTATIC PRESSURE

Oles Lomacky Dec. 1966 42 p refs

(DTMB-2287; AD-645514) CFSTI: HC $3.00/MF $0.65

A method of elastic stress analysis for ring-stiffened circular cylindrical shells with linearly varying tapered insert at the deep frame is presented. The analysis is based on Fourier series expansion and an analogy to beam-columns on elastic foundation. In addition, the experimental data obtained from machined models are in good agreement with the theoretical results. Author (TAB)

N67-22677# Cambridge Acoustical Associates, Inc., Mass.

POINT IMPEDANCE OF LONG CYLINDRICAL SHELLS Final Report

W. Barrie Fraser, Thomas L. Geers, W. James Hadden, Jr., and David Feit Dec. 1966 28 p refs
(Contract NObs-90439)
(U-233-165; AD-646352) CFSTI: HC $3.00/MF $0.65

A procedure is presented for computing the mechanical drive-point impedance of cylindrical shells of effectively infinite length (i.e., no significant reflections from shell extremeties). The impedance of a uniform isotropic infinite cylindrical shell is obtained as the reciprocal of a sum of modal mobilities. Consistently-derived approximate expressions are given for the ranges of frequency and mode number in which simplifying assumptions may be made. It is shown explicitly that the sum of modal mobilities converges to a finite value, except at certain resonant frequencies. Each resonance coincides with the cut-off frequency of a lobar mode below which this mode does not contribute to energy spreading axially from the point of excitation. The significance of these resonances is explored by examining the transient response of a membrane waveguide when it is abruptly excited at one of its resonant frequencies. Author (TAB)

N67-22699# Naval Academy, Annapolis, Md. Engineering Dept.
BEHAVIOR OF STIFFENED PLATES. VOLUME I: ANALYSIS
Charles O. Heller Jan. 1967 211 p refs
(Rept.-67-1; AD-646221) CFSTI: HC $3.00/MF $0.65

A compilation of techniques of analysis for orthogonally stiffened, flat, rectangular plates, with various combinations of loading and support conditions, is presented. The specific types of plates considered are sandwich, corrugated, rib-reinforced, and integrally stiffened. Orthotropic plate theory is used as the major form of solution throughout the report. A complete bibliography, consisting of more than three hundred references, is included. TAB

N67-22730# Wisconsin Univ., Madison.
ANALYTICAL PROCEDURES FOR PREDICTING THE MECHANICAL PROPERTIES OF FIBER REINFORCED COMPOSITES Summary Report Jul. 1965–Aug. 1966
Gerald Pickett and Millard W. Johnson, Jr. Sep. 1966 157 p
(Contract AF 33(615)-2030)
(AFML-TR-65-220, Pt. II; AD-646216) CFSTI: HC $3.00/MF $0.65

Work previously reported on the development of procedures for the calculation of the elastic properties of and stresses in reinforced composite materials is continued. Results are reported for both the hexagonal and the rectangular array of fibers. Results on the elastic properties of and stresses in laminated plates and cylindrical shells are also reported. TAB

N67-22734# Hitco, Gardena, Calif.
RESEARCH IN FABRICATION TECHNIQUES FOR FIBER GLASS REINFORCED PRIMARY AIRCRAFT STRUCTURES
Jay V. Daines Ft. Eustis, Va., Army Aviation Materiel Labs., Oct. 1966 34 p refs
(Contract DA-44-177-AMC-326(T))
(USAAVLABS-TR-66-76; AD-645874) CFSTI: HC $3.00/MF $0.65

The report covers the design, fabrication, and testing of glass reinforced plastic (GRP) 1/2 scale models of a main torsion box assembly incorporating an NACA 642-215 airfoil. The structure was designed as a sandwich wall box beam, with nonwoven oriented (NWO) GRP faces and a GRP honeycomb core. Fabrication techniques for filament winding a double tapered box beam were investigated and a technique was developed which made it possible to filament wind the 45 degrees fibers as well as the hoop and axial oriented fibers. Unidirectional tape, 12 inches wide, made from E-HTS glass filaments and 20 end roving with both E-HTS and S-HTS glass filaments, preimpregnated with an epoxy resin system were utilized in the fabrication of the facings. Both the hand layup and filament winding techniques of fabricating primary aircraft structures were found to be practical and within the current state of the art. Author (TAB)

N67-22735# David Taylor Model Basin, Washington, D. C.
A SUMMARY OF SUBMARINE STRUCTURAL RESEARCH. PART 1: CONVENTIONAL HULL CONFIGURATIONS. CHAPTER 5: STRESSES IN PRESSURIZED SHELLS OF REVOLUTION
Thomas E. Reynolds Dec. 1966 79 p refs
(DTMB-2264; AD-645068) CFSTI: HC $3.00/MF $0.65

Analytical methods utilizing the linear bending theory of thin shells are presented which are judged the most useful for determining stresses in submarine pressure hulls. Only axisymmetric deformations are considered, and emphasis is placed on methods that are sufficiently simple to be applied at the practical level. Attention is restricted to analytical solutions for cylindrical, conical, and spherical shells. Efforts have been made to employ a uniform system of notation and sign conventions wherever possible. Author (TAB)

N67-22738 Northern Research and Engineering Corp., Cambridge, Mass.
THE VIBRATION OF BLADES IN AXIAL TURBOMACHINERY. PART I: THEORY AND PRACTICE OF DESIGN AND DEVELOPMENT
29 Apr. 1965 216 p refs
(Rept.-1088-1; Nobs-92089)
(Rept.-1088-1; AD-645156) CFSTI: $3.00

The volume describes the various causes of vibration together with methods of assessing their seriousness. A program was developed for predicting the natural frequencies of cantilevered blades, as the frequencies of resonant vibrations are usually close to these natural frequencies. Also included is a description of the experimental techniques which may be used to determine the vibrational characteristics of axial-turbomachine blades. Author (TAB)

N67-22753*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME RESULTS IN THE FINITE-ELEMENT MODELLING OF THIN PLATES
Y. Chen and T. G. Toridis (George Washington Univ.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 239–242 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

In an investigation of the finite-element modelling of thin plates, a governing differential equation of the free vibration of the plate is given. The usual assumptions made in the theory of thin plates are considered. The finite-element method of structural analysis is a recent development which solves structural problems by first constructing a model containing finite elements to replace the actual physical structure being analyzed. The study was carried out with the aid of a digital program for static and dynamic analysis of complex structures, which is based on the Matrix-Force method. Experimental results obtained indicate further improvements are needed and additional work is required before acceptable models of the thin plates, and subsequently thick plates, can be obtained. R.Li.

N67-22789# Royal Aircraft Establishment, Farnborough (England).
GENERALIZED AIRFORCES ON A CYLINDRICAL SHELL OSCILLATING HARMONICALLY IN A UNIFORM FLOW
D. E. Davies Dec. 1965 66 p
(RAE-TR-65295)

The flow of air past an infinite shell is considered. In its undisturbed state the shell is a circular cylinder. A portion of the shell between two normal cross sections is flexible, the rest of the shell being rigid and fixed. The flexible portion is closed by

planes normal to the axis of the cylinder. In the absence of any oscillations of the flexible portion there is a uniform flow outside the cylinder, which has the direction of the axis of the cylinder. When the flexible portion oscillates, the uniform flow is perturbed and there is also an acoustic field generated in the space within the flexible portion with the result that there are oscillating perturbation pressures on both sides of the shell surface. A method of determining these perturbation pressures is given when the flexible portion oscillates harmonically with given frequency in a given mode. Expressions for these perturbation pressures are then used to obtain formulas for the associated generalized air forces. Author

N67-22801# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.
MATRIX METHODS IN STRUCTURAL MECHANICS
J. S. Przemieniecki, R. M. Bader, W. F. Bozich, J. R. Johnson, and W. J. Mykytow, ed. Nov. 1966 992 p refs Proc. of the Conf. on Matrix Methods in Structural Mech., held at Wright-Patterson AFB, Ohio, 26–28 Oct. 1965; Sponsored by AF Flight Dyn. Lab. and AF Inst. of Tech.
(AFFDL-TR-66-80; AD-646300) CFSTI: HC $3.00/MF $0.65

Conference papers on general matrix methods, finite element properties, nonlinear effects, dynamics, and applications are presented. For individual titles see N67-22802–N67-22837.

N67-22802 London Univ. (England).
AN APERCU OF RECENT DEVELOPMENTS OF THE MATRIX DISPLACEMENT METHODS
J. H. Argyris *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 11–189 refs (See N67-22801 11-32) CFSTI: HC $3.00
(Contract AF 61(052)-854)

A broad survey of some of the developments in the field of matrix methods of structural analysis achieved at the Institut für Statik und Dynamik in Stuttgart and at Imperial College, London, since 1963 is given. Practically all the material presented, but for a limited number of applications and illustrations, has not been published externally. In view of the very extensive nature of the investigations covering linear and non-linear phenomena in the static and dynamic fields, it has proved necessary to restrict considerably our apercu. This is regrettable, especially for a main address, but inevitable, in view of the limited space available. Some typical investigations are covered in such a manner that they could be immediately applied by the specialist. In view of this policy, it was decided to concentrate on unpublished developments of the Matrix Displacement method but even here a number of important topics have had to be omitted. In particular, our applications on visco-elastic and other time-dependent effects on structures are not covered, although the technique is essentially included in sections on the analysis on elasto-plastic phenomena. Author

N67-22803# North American Aviation, Inc., Los Angeles, Calif.
A REGULARIZATION METHOD FOR CALCULATION OF STRESSES, DEFORMATIONS, AND ELASTIC MODES
Robert W. Falconer and Robert D. Lane *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 191–204 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

A realistic approach using orthogonalization of the structure is presented for obtaining the elastic response of highly redundant airframe systems. The regularized method is an orderly procedure for formulating the mathematical structural idealization in a manner that will require a minimum of calendar time from conception to solution by high-speed digital computers. The method has been under development since 1960, and was directed toward improving the digital analysis procedures developed for and employed on the XB-70 wing. This vehicle provided a realistic application of the analysis methods to a large, redundant, airframe structure. The objectives attained were: (a) realistic accuracy, (b) minimum programming and computer time, (c) reduction of potential program data errors, and (d) rapid cycle design data for configuration optimization. Since static and dynamic analyses requirements are interdependent, the necessary detail of a static analysis can delay the attainment of a compatible dynamic matrix. Conversely, the expedient alternative of approximating elastic characteristics by a coarse grid network analogy sacrifices accuracy for time. Regularization materially reduced the time lag between static and dynamic analyses of redundant structures, and still provides highly accurate solutions. Author

N67-22804# Boeing Co., Seattle, Wash.
A SURVEY OF ANALYSIS OF SHELLS BY THE DISPLACEMENT METHOD
R. E. Jones and D. R. Strome *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 205–229 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

A study of the current state of the art in the analysis of elastic shells by the direct stiffness method is presented. The considerations deal chiefly with linear, static problems. The capabilities and weaknesses of the conical shell element and a newly developed curved element are studied in depth. Criteria are given which predict the necessary smallness of elements required to obtain shell stress analyses with acceptable levels of accuracy. The applicability of the current analysis methods to vibrations and to nonlinear problems is discussed. The development of a polygonal curved shell element, which is the major gap in the current set of analysis tools, is discussed briefly. Author

N67-22805# Bell Aerosystems Co., Buffalo, N. Y.
DEVELOPMENT OF ADVANCED STRUCTURAL OPTIMIZATION PROGRAMS AND THEIR APPLICATION TO LARGE ORDER SYSTEMS
Ronald A. Gallatly and Richard H. Gallagher *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 231–251 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Contract AF 33(657)-11748)

The methods of matrix structural analysis have been coupled with some of the techniques of operations to provide integrated computer programs capable of performing the fully automated design of minimum weight structures subjected to a multiplicity of loading conditions. The present paper discusses some methods used in the development of such programs. Details of the analysis methods including the discrete elements contained in the program library are presented along with a description of the search procedure used to find the minimum weight. Two new programs and their possible range of practical applications are discussed and the paper is concluded with some brief remarks on prospects for future developmental research. Author

N67-22806# British Aircraft Corp., Preston (England).
AUTOMATED STRESS ANALYSIS USING SUBSTRUCTURES
I. C. Taig *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 255–274 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The concept of subdivision of structures into any number of substructure levels is presented and the requirements for introducing this concept into automated stress analysis are discussed. The principles of substructure analysis are summarized and related to conventional matrix stress analysis techniques. A range of practical applications of substructure analysis is considered and potential benefits in reducing problem formulation and increasing analytical flexibility are described. Applications include partial solution of large structures, reduction of repetitive data preparation, automated idealization and subdivision and systematic modification of structures. An automated stress analysis scheme currently under development is briefly described, with particular attention given to the

implementation of substructure analysis facilities. The organization of the scheme is outlined in three parts:—expansion of condensed data, assembly of structural behavior data and solution and backsubstitution. Finally the question of selecting and condensing the voluminous data output is considered. Author

N67-22807# Aerospace Corp., San Bernadino, Calif.
A STUDY OF THE MATRIX DISPLACEMENT METHOD AS APPLIED TO SHELLS OF REVOLUTION
Stanley Klein *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 275–298 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The paper describes the particular application of the matrix displacement finite element approach to the linear elastic analysis of shells of revolution under axisymmetric and asymmetric loads. The shell is idealized as a series of conical frusta, joined at nodal circles. The external forces are applied at the nodal circles. Problems encountered in the development of the method are discussed in detail and solutions to the various difficulties are outlined. Computer codes based on this technique are used to obtain a variety of solutions for simple and complex shell structures. These solutions illustrate the accuracy of the method in addition to indicating sources of error pertaining to the modeling technique employed for different shells. Improvements of the computer codes, methods of increasing the number of finite elements allowed, machine computation time required, and extensions of the analysis are all topics discussed in depth. Author

N67-22808# Aerospace Corp., San Bernardino, Calif.
THE LINEAR ELASTIC DYNAMIC ANALYSIS OF SHELLS OF REVOLUTION BY THE MATRIX DISPLACEMENT METHOD
Stanley Klein and Richard J. Sylvester *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 299–328 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The paper describes the matrix displacement finite element approach to the linear elastic dynamic analysis of shells of revolution under axisymmetric and asymmetric loads. The shell is idealized as a series of conical frusta, joined at nodal circles. The derivation of the mass and stiffness matrices for a shell structure is outlined. A method for solution of the equations of motion is described for this particular type of problem, with special emphasis on the computational aspects of the solution. An especially appropriate finite difference technique is used along with a method for efficiently utilizing the digital computer memory to store and solve a large system of linear simultaneous equations. The solution for a shallow spherical cap under time varying axisymmetric pressure load indicates the scope, speed, and accuracy of the solution method. Author

N67-22809# National Aeronautical Establishment, Ottawa (Ontario).
THE EQUIVALENCE OF FORCE AND DISPLACEMENT METHODS IN THE MATRIX ANALYSIS OF ELASTIC STRUCTURES
Eryk Kosko *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 329–351 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The four sets of variables occurring in the linear theory of structures, and the basic relations between them are defined in terms of the theory of finite-dimensional vector spaces. The two types of methods in practical use, mentioned in the title, are derived in a uniform manner, and the equivalence of these two methods is established by comparing the resultant matrices with those obtained by inverting the so-called structural matrix, suitably partitioned in each case. Discussion is limited to problems where loads are applied at joints only, but should be applicable to wider class. Conclusion: the two methods are not dual to each other, as sometimes stated, but variables are. Vector space approach is found more general and better suited to structure analysis than systems or network theory. Author

N67-22810# North American Aviation, Inc., Los Angeles, Calif.
STRUCTURAL INFLUENCE COEFFICIENTS FOR A REDUNDANT SYSTEM INCLUDING BEAM-COLUMN EFFECTS
William P. Rodden *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 353–383 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

A Force Method is presented for the solution of the structural influence coefficients (SICs), internal load distribution, and buckling characteristics of a redundant elastic beam system including beam-column effects. The formulation is general to the extent of considering each structural element to have both variable bending and shear flexibilities; the extension to include torsion and axial flexibilities is indicated. An iterative procedure is developed for the analysis of the most general redundant case in which beam-column effects cause interaction between the external loading and the redundant internal reactions. The method of solution is illustrated by three examples. The first two examples deal with a doubly redundant two member frame under two types of loading: a panel point loading, and a transverse loading at an intermediate point on one of its members. The first example leads to a straight forward redundant beam-column problem since the axial loading of the two members is known at the outset. The second example leads to a nonlinear beam-column problem requiring the iterative solution and provides an illustration of the general procedure. The third example is a case of non-conservative loading, a clamped column tangentially loaded at its free end. The derivation of the static SICs is shown, and the non-conservative buckling load is determined by utilizing the unsymmetrical SICs in vibration analyses up to the point of frequency coalescence. Author

N67-22811# Instituto Technologico de Aeronautica, Sao Paulo (Brazil).
ORTHOGONALIZATION OF INTERNAL FORCE AND STRAIN SYSTEMS
Fernando Venancio Filho *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 385–393 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

A specialization of the Schmidt method of orthogonalization in structural analysis is developed matrically. In the force method of analysis the orthogonalization of the internal force systems leads to a diagonal flexibility matrix. In the displacement method the orthogonalization of the internal strain systems leads to a diagonal stiffness matrix. A comparative analysis concerning the aspects of computational procedure and computer memory requirements is made between the above method and the one of finding the eigenvalues and eigenvectors of the flexibility or stiffness matrices. A computer program flow chart for orthogonalization by the Schmidt Method and a simple example of the building of a set of orthogonal strain systems are presented. Author

N67-22812 Case Inst. of Tech., Cleveland, Ohio.
THE GENERATION OF INTER-ELEMENT-COMPATIBLE STIFFNESS AND MASS MATRICES BY THE USE OF INTERPOLATION FORMULAS
F. K. Bogner, R. L. Fox, and L. A. Schmit, Jr. *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 397–443 refs (See N67-22801 11-32) CFSTI: HC $3.00
(Contract AF 33(615)-1022)

A general method of generating subelement displacement states which makes it a relatively simple task to insure completely compatible displacement states is presented. The method involves the use of Hermite interpolation formulas of various order. The total potential energy principle is used to generate stiffness matrices

based on these displacement states. The approach is presented in general orthogonal curvilinear coordinates for shell type structures. Inter-element-compatible stiffness matrices are presented for a rectangular membrane, a rectangular plate with twelve degrees of freedom, and a rectangular plate with twenty four degrees of freedom. The corresponding consistent mass matrices are presented for both plate elements. Numerical examples of static deflection analysis are presented based on both of the plate subelements and the monotonic convergence of the discretization error is confirmed. Application of the simpler plate subelement to the determination of natural modes and frequencies is also illustrated with a numerical example. All of the examples are selected so that comparison with classical results can be made. Author

N67-22813# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MODIFIED POTENTIAL ENERGY MASS REPRESENTATIONS FOR FREQUENCY PREDICTION
Robert J. Melosh (Philco Corp., Palo Alto, Calif.) and Theodore E. Lang *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 445–455 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Contract NAS7-100)

Mass representations are derived based on complementary energy requirements for computation of frequencies of systems composed of rods, torque tubes, and beams with nondiscrete masses. Modified mass representations are then derived which reduce the error for upper-bound frequency predictions for systems with uniformly distributed masses. Sample problems are solved illustrating that low-error estimates are obtained for a variety of boundary conditions with few elements. Author

N67-22814# Massachusetts Inst. of Tech., Cambridge.
ELEMENT STIFFNESS-MATRICES FOR BOUNDARY COMPATIBILITY AND FOR PRESCRIBED BOUNDARY STRESSES
Theodore H. H. Pian *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 457–477 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Grant AF-AFOSR-347-64)

A method for the derivation of element stiffness matrices based on the principle of minimum complementary energy employing assumed stress distribution is described. Two different types of elements are considered: (1) one which is constrained at the entire boundary, and (2) one which has prescribed stresses along the boundary. The result shows that by using sufficiently large number of terms for the assumed stress distribution, a converging stiffness matrix can be obtained. Example calculations for rectangular panels in plane stress condition and for square plates in bending indicate an improvement in structural analysis when the element stiffness matrices satisfy complete boundary compatibility and boundary stress conditions. Author

N67-22815# Technische Hochschule Hannover (West Germany).
DYNAMIC STIFFNESS MATRIX FORMULATION BY MEANS OF HERMITIAN POLYNOMIALS
Eduard C. Pestel *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 479–502 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Hermitian polynomials are used for the approximation of the deformation of structural components, such as beam- and plate-elements. In the case of one-dimensional problems (bars, beam, arches, frames) the establishment of the elastic stiffness matrix and of the mass matrix is straightforward, if the order of the Hermitian polynomials is equal to the order of the differential equation for the structural component. However, higher-order Hermitian polynomials can be employed in order to obtain the dynamic stiffness matrix for such structural element. Due to the matrix condensation, necessary in this case, the dynamic stiffness matrix can no longer be split into separate mass- and elastic matrices. It has been found that the use of higher-order polynomials yields more accurate results at less computational expense compared with the procedure where the structure is divided into more individual segments whose stiffness and mass matrices are established by means of polynomials of order equal to that of the differential equation. The application to plates is somewhat more intricate, since the condensation technique is somewhat problematic. Two ways of solving this dilemma are indicated. Author

N67-22816# Philco Corp., Palo Alto, Calif. Western Development Lab.
A FLAT TRIANGULAR SHELL ELEMENT STIFFNESS MATRIX
Robert J. Melosh *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 503–514 refs Prepared for JPL (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Contract NAS7-100)

The derivation of the equations for a flat-plate triangular element applicable to the analysis of shell-like structures using the direct stiffness method is presented. The element accounts for membrane and bending flexibility and material properties ranging from isotropic to aeolotropic. The derived element satisfies requirements on macroscopic equilibrium and intra-element deformation compatibility for non-planar arrays, but approximates the deformation state conditioned by bending and shear stresses acting over the elements. Computed results demonstrate that the derived element is satisfactory for predicting deflections and slopes when shear rigidities are very high or low. Author

N67-22817# California Univ., Berkeley.
FINITE ELEMENT STIFFNESS MATRICES FOR ANALYSIS OF PLATE BENDING
Ray W. Clough and James L. Tocher (Boeing Co., Renton, Wash.) *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 515–545 refs Prepared jointly with Boeing Co., Renton, Wash. (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Grants NSF G-7337; NSF G-18986)

A study is made of the relative accuracy provided by seven different types of finite elements in the approximate analysis of plate bending. The Kirchoff plate bending theory is assumed, and stiffness matrices for three rectangular and four triangular elements are considered. Included among these is a newly developed triangular element which provides for full displacement compatibility along the edges of adjacent elements. Analyses are made with each of these elements of the central deflection in eight different rectangular plate systems, using five different mesh sizes. Two of the rectangular elements and the compatible triangular element are found to give results which converge toward the correct answer as the mesh size is refined. Author

N67-22818# Rolls-Royce, Ltd., Derby (England). Stress Office.
TRIANGULAR ELEMENTS IN PLATE BENDING—CONFORMING AND NON-CONFORMING SOLUTIONS
G. P. Bazeley, Y. K. Cheung, B. M. Irons, and O. C. Zienkiewicz (Univ. Coll. of Swansea) *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 517–576 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Suitable stiffness characteristics of triangular plate elements in bending are studied. The success of the direct deflection approach in establishing these properties for rectangular elements using simple polynomials and an initial failure of a similar approach of dealing with triangular elements led to some unjustified conclusions concerning necessary convergence criteria. In dealing with the triangular plate element several alternative derivations are presented, based on various explicit types of displacement functions. The new requirement of 'constant curvature' is satisfied and, all but one satisfy completely the compatibility conditions. The displacement

functions use the so-called area coordinates to ensure symmetry and simplicity of statement. The new formulation is applied to the solution of some typical static and dynamic plate problems. Good convergence and accuracy is achieved by the new stiffness matrices. The results are of comparable accuracy with those attainable by the use of rectangular elements. The non-compatible type of solution appears to give better accuracy than the compatible one for practical element sizes. Author

N67-22819# California Univ., Berkeley.
A BENDING ANALYSIS FOR PLATES
L. R. Herrmann *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 577–602 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

A general, approximate solution method applicable to the bending analysis of structural plates is presented and illustrated. The analysis includes the effects of shearing deformations and is applicable to both thin and moderately thick plates. The plate bending equations written as functions of the transverse deflection, and the bending moments are expressed by a variational theorem. The plate to be analyzed is represented by a series of finite elements. Forms of the primary dependent variables are assumed within each element and related to their values at the element nodes. The approximate solution is obtained by taking the variational of the function with respect to the node values of the unknowns, thus generating a set of linear algebraic equations which define these node values. The rotations and shears are calculated from the values of a deflection and moments. R.Ll.

N67-22820# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
MATRIX ANALYSIS METHODS FOR INELASTIC STRUCTURES
W. Lansing, W. R. Jensen, and W. Falby *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 605–633 refs (See N67-22801 11-32 CFSTI: HC $3.00/MF $0.65

One of the methods proposed in the literature for predicting the influence of plasticity in redundant structures is reviewed. It is essentially a step by step calculation procedure, and corresponds to the flow theory of plasticity. The method has been introduced into a standard, initial strain influence coefficient formulation and applied to a 2024-T4 aluminum alloy shear lag structure which has been tested previously for the Air Force. The resulting correlation between predicted and test results is reasonably good. The computer program has also been modified to yield a deformation theory solution for the same structure; the numerical results are extremely close to those of the flow theory. In addition to this, primary creep is considered; the predicted strain distributions in an 1100-F aluminum shear lag structure again agree reasonably well with test values. Finally, it is observed that in all these cases the calculation step size is vitally important, and a simple, straightforward procedure is recommended as a check. Author

N67-22821# Royal Aircraft Establishment, Farnborough (England).
THE APPLICATION OF THE MATRIX DISPLACEMENT METHOD IN PLANE ELASTO-PLASTIC PROBLEMS
Geoffrey G. Pope *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 635–654 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

A procedure is developed for the analysis of elasto-plastic plane stress and plane strain problems when the stress-strain relations are of the incremental type. The stressed region is divided for purposes of analysis into triangular elements and the deformation is analysed on a step-by-step basis, using the matrix displacement method. The deformational characteristics of a typical yielded element when the loading is increased by a small increment are expressed in terms of simple basic matrices describing the elastic properties, the derivatives of the yield surface with respect to the stress components, the work-hardening properties, and the geometry of the element. Simple applications are described. Author

N67-22822# Technische Hogeschool, Delft (Netherlands).
MATRIX ANALYSIS OF CREEP AND PLASTICITY PROBLEMS
J. F. Besseling *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 655–677 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Matrix analysis of structures is an algebraic analogy of the continuous field theory for the description of the mechanical behaviour of solid bodies. Fields are replaced by vectors with a finite number of elements. The displacement vector defines the generalized strains of the various structural elements and these generalized strains may be considered as a superposition of elastic-, thermal- and inelastic-components. For the inelastic-components of the generalized strains a theory of creep and plasticity is developed that is fully analogous to the continuous field theory of creep and plasticity. In the case of a structure, composed of elements subject to creep, the deformation problem is solved by integration of a system of first order differential equations. Plastic deformation in a number of structural elements, on the other hand, gives rise to a step by step modification of the elastic solution of the deformation problem. Author

N67-22823# General Dynamics/Convair, San Diego, Calif.
NONLINEAR STRUCTURAL ANALYSIS; TENSOR FORMULATION
J. W. Wissmann *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 679–696 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Using the approach of the stiffness method of matrix structural analysis, the mathematical model of a general nonlinear structure is derived in Cartesian tensor notation. Included in the formulation are temperature expansion, pre-stresses, pre-strains, and general anisotropies. The basis of the derivations is the fundamental strain expression of nonlinear theory of elasticity which allows rotations of arbitrary magnitude. Consequently, the method may be used for the analysis of highly flexible structures or even elastic linkages. The structural elements used are topological simplexes, i.e. bars, triangles, and tetrahedrons; their linearized models are compared with previously known results. Due to the discrete point and element representation of numerical methods, some non-tensor properties evolve which require a generalization of tensor algebra. The resulting index notation allows a direct translation into computer program languages and provides several computational shortcuts over matrix notation. The system equations are of the third order in the displacements. Stability criteria are derived and suitable iteration schemes for a static solution are discussed using a simple example problem for illustration. Author

N67-22824# Washington Univ., Seattle.
ON THE DERIVATION OF STIFFNESS MATRICES FOR THE ANALYSIS OF LARGE DEFLECTION AND STABILITY PROBLEMS
Harold C. Martin *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 697–716 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The derivation of stiffness matrices necessary for analyzing large deflection and stability problems is developed from basic nonlinear theory. Detailed derivations are given for the stringer, beam-column, and arbitrary thin triangle in plane stress. A suggestion is offered for representing large deflection behavior of the triangular element in bending. A brief account of previous contributions is included. Author

N67-22825# Manchester Coll. of Science and Technology (England).
THE EFFECT OF AXIAL LOADS ON THE STIFFNESS OF RIGID-JOINTED PLANE FRAMES

S. J. Mc Minn *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 717–726 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The effect of axial loads on the members of a skeletal frame is to alter the stiffness of each from that usually taken in the orthodox "slope-deflection" analysis. By means of a Rayleigh–Ritz analysis it is shown that the use of tables of stiffness and carry-over factors may be avoided. Ultimately it is shown that the stiffness matrix K for the frame may be expressed in the form $K = K_0 - \lambda L_1 - \lambda^2 L_2 - \lambda^3 L_3 - \cdots \infty$ where K_0 is the stiffness matrix obtained by ignoring the effect of axial loads λ is a load factor L_1, L_2 etc are matrices that can be calculated at "unit load", that is for $\lambda = 1$. Author

N67-22826# Bell Aerosystems Co., Buffalo, N.Y.

THE COMPUTATION OF DYNAMIC RESPONSE TIME HISTORIES OF A SYSTEM USING A MATRIX ITERATIVE TECHNIQUE

Benjamin B. D'Ewart and Robert F. Farrell *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 729–742 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Second order differential equations of motion in matrix form are written for solution of instantaneous accelerations for each degree of freedom in response to imposed conditions. These accelerations are used to establish velocity and displacement changes from initial conditions which are then summed to produce time histories. Two examples are given. The first traces out the motions of fluttering wing. The second simulates a closed, one dimensional acoustic chamber and demonstrates a resonant frequency response and speed of sound effects. R.LI.

N67-22827# Illinois Univ., Urbana.

A METHOD FOR THE DETERMINATION OF THE MATRIX OF IMPULSE RESPONSE FUNCTIONS WITH SPECIAL REFERENCE TO APPLICATIONS IN RANDOM VIBRATION PROBLEMS

Y. K. Lin *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 743–752 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The impulse response function, $h_{jk}(t)$, of a linear structure gives the response at point j due to a unit impulse excitation at point k applied at time t=0. When the damping in a structure is such that the normal modes of vibration do not exist, the matrix of impulse response functions is usually difficult to determine. In the present paper the determination of this matrix is discussed under rather general conditions. A method is reviewed first, then an alternative scheme more convenient in some cases is presented. An example is given to illustrate the alternate procedure. The role of the matrix of impulse functions in the random vibration analysis is also noted. Author

N67-22828# Illinois Univ., Urbana.

NUMERICAL APPROACH FOR WAVE MOTIONS IN NONLINEAR SOLID MEDIA

Alfredo H.-S. Ang *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 753–778 refs CFSTI: HC $3.00/MF $0.65
(Contract AF 29(601)-5851; Grant NSF GP-984)

The development of a lumped-parameter model of three-space solid media and its important definitions and properties are described. Field problems of solid media can be formulated with reference to the model, resulting in a system of recursive equations which are obtained on the basis of fundamental principles of mechanics and basic material behavior. The equations of the model are also shown to be central finite difference analogues of the differential equations of the corresponding continuum model. Although the model is applicable to many static and dynamic problems of solid media, the application of the approach is illustrated with dynamic problems of wave propagations in spherically and axially symmetric solids. Author

N67-22829# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio

QUADRATIC MATRIX EQUATIONS FOR DETERMINING VIBRATION MODES AND FREQUENCIES OF CONTINUOUS ELASTIC SYSTEMS

J. S. Przemieniecki *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 779–802 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The mathematical idealization of vibrating continuous elastic systems into discrete element systems, as used in matrix analysis, leads to the equation of motion in the form of an infinite matrix series whose coefficients involve ascending powers of the frequency. The equation of motion of the idealized discrete system is of the form $(A - \omega^2 B - \omega^4 C - \ldots)\, q = 0$ where the matrices A,B,C ... depend on the inertia and stiffness properties of the system. ω is the circular frequency, and q is the column matrix of discrete displacements. The conventional analysis uses only the first two terms of the matrix series and it leads to the characteristic equation of the form $|A - \omega^2 B| = 0$. If the next higher order term is retained, then the equation of motion is a quadratic matrix equation in ω^2 and the characteristic equation becomes $|A - \omega^2 B - \omega^4 C| = 0$. The formation of the quadratic matrix equation of motion and its solution are discussed. Details of the method are presented for structures made up from bar and beam elements. Some typical numerical examples of the method are presented, including a comparison with the conventional eigenvalue solutions to demonstrate the considerable improvement in accuracy of the calculated vibration modes and frequencies when the term with frequency to the fourth power is retained in the equation of motion for the vibrating elastic system. Author

N67-22830# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TRUNCATION ERRORS IN NATURAL FREQUENCIES AS COMPUTED BY THE METHOD OF COMPONENT MODE SYNTHESIS

Walter C. Hurty *In* AFSC Matrix Methods in Structural Mech. Nov. 803–821 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Contract NAS7-100)

A method for estimating the errors in computed natural frequencies of a structure attributable to truncation of the generalized coordinate system is provided. The study is confined to those mass and stiffness matrix arrangements associated with a particular method of analysis described elsewhere as the method of component mode synthesis. An equation is developed which permits estimates to be made of these errors. Application to an example shows that the frequency corrections are not very accurate because of approximations involved in the analysis. Despite this there appears to be good correlation between the calculated errors and the accuracy of computed modes. Hence, the method appears to be useful in providing criteria of modal accuracy. Further applications to various structures are required in order to establish confidence levels for these criteria. Author

N67-22831# TRW Systems, Redondo Beach, Calif.

IMPROVED LINEAR AXISYMMETRIC SHELL-FLUID MODEL FOR LAUNCH VEHICLE LONGITUDINAL RESPONSE ANALYSIS

J. S. Archer and C. P. Rubin *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 823–847 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Contract NAS1-4351)

An improved linear analytical model is developed for the calculation of axisymmetric launch vehicle longitudinal vibration modes and steady-state response to applied axisymmetric harmonic loads. This approach utilizes a finite element technique to construct the total vehicle stiffness and mass matrices by subdividing the structure into a set of axisymmetric shell components, fluid components, and spring-mass components. The total vehicle

characteristics are obtained by super-position of the stiffness and mass matrices of the individual shell, fluid and spring-mass components. General expressions for the stiffness and mass matrices of conical and ellipsoidal shells of revolution are derived taking into account the initial stresses. The fluid mass matrix is derived using fluid motions which are consistent with the shell component distortions. The natural frequency solution of a typical launch vehicle configuration is presented for illustration and contrasted with the results obtained from a lumped spring-mass model. Author

N67-22832# General Dynamics/Fort Worth, Tex.
VIBRATION ANALYSIS OF A CANTILEVERED SQUARE PLATE BY THE STIFFNESS MATRIX METHOD
G. C. Best *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 849–860 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

The analytical development of the stiffness matrix of a triangular flat plate in bending is presented. The method used employs a stress assumption containing eleven constants as against six force/deflection coordinates in the supported element, the excess constants being adjusted so as to minimize a positive function involving edge stresses. The assumption is made so as to satisfy both the differential equations of equilibrium and compatibility. A square cantilevered plate of constant thickness is then simulated by a mesh of these triangles and vibration frequencies and locations of node lines computed. Results are compared with those of another author obtained by a classical solution employing Fourier's series. Author

N67-22833# Liege Univ. (Belgium).
BENDING AND STRETCHING OF PLATES—SPECIAL MODELS FOR UPPER AND LOWER BOUNDS
B. Fraeijs de Veubeke *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 863–886 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65
(Contract AF 61(052)-892)

The purpose of this report is to deal with certain difficulties arising in the construction of equilibrium models and displacement models of finite elements, yielding upper bounds or lower bounds to static influence coefficients. The constraints imposed on the number of parameters of the displacement field or the stress field, in relation to the number of generalized coordinates, in order to achieve either continuity of displacements or continuity of stress transmission within the structure, are sometimes hard to satisfy. Two cases are presented, a displacement model for bending and an equilibrium model for stretching, where the difficulties are removed by a particular grouping of elements in a larger building block. To make the report self-contained, the dual theories of displacement and equilibrium models are briefly reviewed. Author

N67-22834# North American Aviation, Inc., Downey, Calif.
MATRIX ERROR ANALYSIS FOR ENGINEERS
R. A. Rosanoff and T. A. Ginsburg *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 887–910 refs (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Topics from the mathematics of matrix error analysis are reviewed. It is demonstrated that numerically unstable equations do arise in physically stable problems. It is shown that unstable equations result from an absence of information so that preconditioning techniques or optimum inversion routines inherently must be of limited value. The analysis indicates that a new set of equations is the cure for ill-conditioned matrices. Thus, a great need is indicated for routine measurement of matrix conditioning numbers associated with various patterns of formulation. Some patterns, which arise in practice, are shown. Author

N67-22836# Technische Hogeschool, Delft (Netherlands).
A FINITE ELEMENT-METHOD FOR THE DETERMINATION OF NON-STATIONARY TEMPERATURE DISTRIBUTION AND THERMAL DEFORMATIONS
W. Visser *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 925–943 refs (See N67-22801 11-32) CFSTI: $3.00/MF $0.65

In the finite element-method based on the principle of minimum potential energy, the so-called displacement-method, a given temperature distribution can easily be taken into account. In this paper a variational principle for linear heat flow problems has been formulated analogous to the principle of minimum potential energy. On the basis of this variational principle the temperature distribution can be derived by means of a finite element-method. The determination of the thermal deformations then follows as a natural sequel to these computations. For both successive problems the same division in elements is required. In this paper the necessary matrices have been derived. Two examples illustrate the application of the method. Author

N67-22837# Martin Co., Denver, Colo.
TITAN III 20 PERCENT DYNAMIC MODEL CHARACTERISTICS—COMPARISON OF THEORY AND EXPERIMENT
Georgr Morosow and Ivan J. Jaszlics *In* AFSC Matrix Methods in Structural Mech. Nov. 1966 p 945-973 (See N67-22801 11-32) CFSTI: HC $3.00/MF $0.65

Although the theory used to obtain dynamic characteristics of aerospace structures has been developed to a considerable extent, there are times when experimental verification is required, especially when the structure is unconventional or extremely complex. This has been the case with Titan III. The vibration analyses of various Titan III configurations have been performed using the eigenvalue solution for a system of 80 degrees of freedom. This number of coordinates is required because the motion occurs in more than one direction simultaneously. The results of the analyses have been compared with the experimental data obtained from the vibration test of a 20 percent dynamically similar model at NASA, Langley Field, Hampton, Virginia. The comparison demonstrated a high degree of accuracy of the analytical results. It further demonstrated that model testing technique is, in most cases, an adequate substitute for full scale testing. Author

N67-22881*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FINITE ELEMENT MODELING OF A CANTILEVER BEAM
Jerry F. Kuzanek Mar. 1967 33 p
(NASA-TM-X-55743; X-321-67-97) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Three finite element models of uniform beams were designed for digital computer analysis in an effort to approximate the first twenty-five transverse frequencies and mode shapes of a 1"×1"×25" aluminum cantilever beam. The first model accounted for only the bending properties in the beam; the second model accounted for rotatory inertia in the beam in addition to bending; and the third model accounted for shear flexibility in the beam in addition to bending and rotatory inertia. The results from the first model were compared with the results according to the Bernoulli-Euler theory of the transverse vibrations of uniform beams; those from the second model with those according to the Rayleigh theory; and those from the third model with those according to the Timoshenko theory. In general, the agreement between model and theory was excellent. In order to ascertain the applicability of the third model to thicker beams, in which shear flexibility becomes increasing more important, an aluminum cantilever beam 10" thick, 5" deep, and 25" long was considered. Once again the agreement between the finite element model and the applicable Timoshenko theory was excellent. Author

N67-22925 European Atomic Energy Community, Brussels (Belgium).
THE HEAT-AFFECTED ZONE OF THE PLATE AND ITS IMPORTANCE AS REGARDS VESSEL EMBRITTLEMENT DURING FABRICATION AND IN SERVICE [LA ZONE DE LA TOLE INFLUENCEE THERMIQUEMENT PAR LE SOUDAGE. SON IMPORTANCE DU POINT DE VUE FRAGILISATION DE LA CUVE EN FABRICATION ET EN SERVICE]
J. Sebille Jan. 1967 38 p refs Presented at the Panel of Experts on Recurring Inspection of Nucl. Reactor Steel Pressure Vessels, Pilsen (Czech.), 3–7 Oct. 1966
(EUR-3310.f; EURAEC-1751) CFSTI: HC $3.00

For application to steel vessels of light water reactors, the thermal and mechanical properties of heat treated steel plates were investigated. Steel and electroslag heat-treated materials are considered. Structure and metallurgical processing are emphasized. Tests for irradiation effect, deformation, elasticity, and rupture are also mentioned. Transl. by R.Ll.

N67-22976 European Organization for Nuclear Research, Geneva (Switzerland).
LONGITUDINAL INSTABILITIES OF AZIMUTHALLY UNIFORM BEAMS IN CIRCULAR VACUUM CHAMBERS WITH WALLS OF ARBITRARY ELECTRICAL PROPERTIES
A. Sessler and V. Vaccaro 6 Feb. 1967 27 p refs
(CERN-67-2) CFSTI: HC $3.00

The possible longitudinal instabilities of a centrally located beam in a tank of circular cross section are investigated. The tank walls are taken to be non-perfectly conducting and to have some distributed transverse admittances and longitudinal impedance. It is assumed that these impedances consist of many elements such that each element has a length which is small compared to the wavelength of the perturbation. Author

N67-22989# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
ON THE DETERMINATION OF SHELLS BEYOND THE ELASTIC RANGE [SUR LE CALCUL DES COQUES HORS DU DOMAINE ELASTIQUE]
Roger Valid 1966 118 p refs In FRENCH; ENGLISH summary
Its Note Tech. No. 102
CFSTI: HC $3.00/MF $0.65

A general shell theory, including all shapes and loads, is developed; it uses the principle of virtual displacements where the displacements are compatible with the Kirchhoff-Love assumptions extended so as to take account of the thickness variation. This method has the advantage of giving directly the necessary and sufficient conditions for equilibrium as well as the boundary-conditions concerning the above assumptions. The equations are first written in their intrinsic form and then developed in a local reference system. A law of a general type applicable to the behavior of the material is proposed and introduced in a step-by-step method permitting the calculation for large deformations and beyond the elastic range (plasticity and creep). On this purpose, the linearized general formulas are provided. Then the equations are developed in the case of a shell of revolution axi-symmetrically loaded. Author

N67-23020 Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
FATIGUE TEST RESULTS OF THREE FULL-SCALE WING CENTER SECTIONS UNDER CONSTANT-AMPLITUDE LOADING
J. Schijve and P. de Rijk Nov. 1965 42 p refs
(NLR-TM-S.640; ICAF-334) CFSTI: HC $3.00

In addition to previous random and program tests, with and without ground-to-air cycles, and tests with ground-to-air cycles only, three tests were carried out with different constant gust load amplitudes. Results are reported on critical locations, fatigue lives, scatter, crack propagation and damage calculations. A preliminary analysis is given. A survey report on all tests will be issued later. Author

N67-23076# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
VIBRATIONS OF ELASTICALLY RESTRAINED THIN CYLINDRICAL SHELLS SUBJECTED TO VISCOUS DAMPING [SUR LES VIBRATIONS DES COQUES CYLINDRIQUES MINCES SOUMISES A UN AMORTISSEMENT VISQUEUX]
S. J. Britvec 1966 55 p refs In FRENCH; ENGLISH summary
(ONERA-TN-101(1966)) CFSTI: HC $3.00/MF $0.65

The study concerns the vibrations of a thin cylindrical shell subjected to slight damping and an elastic restraint along the boundaries. Under these conditions, the behavior of the shell is close to that associated with the eigenvalue solution which is obtained in the absence of damping and the small elastic restraint. Thus a perturbation technique can be applied to the parameters in the free state, corresponding to the eigenvalue solution, to obtain the solution of the response of the structure in the presence of damping and arbitrary elastic and geometrical conditions along the boundaries. Author

N67-23116# David Taylor Model Basin, Washington, D. C.
INVESTIGATION OF FILAMENT REINFORCED PLASTICS FOR DEEP-SUBMERGENCE APPLICATION
Kenneth Hom and William P. Couch Nov. 1966 67 p refs
(DTMB-1824; AD-645950) CFSTI: HC $3.00/MF $0.65

The results to date of structural research programs to investigate lightweight, glass-reinforced plastics or composite materials for deep-submergence vehicles are summarized. Of significance from these studies is the need to consider effects attributable to the matrix material and bonding between fibers and matrix, that is, maintaining integrity of the structure in a water environment under high pressure and utilizing hull concepts which lend themselves to shear-sensitive materials. Plans for present and future structural research to study more extensively the use of fiber-reinforced plastic materials for pressure hull applications are also reviewed. Author (TAB)

N67-23118# Army Materials Research Agency, Watertown, Mass.
THE EFFECTIVE CRACK LENGTH OF AN EDGE SLOT IN A SEMI-INFINITE SHEET UNDER TENSION
Oscar L. Bowie and Donald M. Neal Nov. 1966 79 p refs
(AMRA-TR-66-35; AD-646824) CFSTI: HC $3.00/MF $0.65

The rate of change of the elastic strain energy with respect to notch depth is considered for edge notches or slots with a finite constant radius, rho at the tip. Numerical results are obtained for an edge slot in a semi-infinite sheet under tension. It is found that the slot can be considered as a crack of length L + 1.18 rho for this purpose. In finite sheet, this result is valid for small L/rho ratios. Author (TAB)

N67-23180# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
INDETERMINATE ELASTIC, WORKHARDENING BEAMS
S. Nemat-Nasser and W. Prager Jan. 1967 23 p refs
(Contract N00014-67-A-0109-0003)
(TR-4; AD-645197) CFSTI: HC $3.00/MF $0.65

An integral equation is established for the rate of change of the bending moment in an indeterminate elastic, workhardening beam that is caused by a given rate of loading. Methods of solving this integral equation are discussed and illustrated by examples. TAB

N67-23253*# Northrop Corp., Hawthorne, Calif. Norair Div.
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF LOCALIZED STRUCTURE TO BE USED IN LABORATORY VIBRATION TESTING OF SHELL STRUCTURE-MOUNTED COMPONENTS, SATURN V PROGRESS REPORT, MAY-NOV. 1966
Chintsun Hwang and W. S. Pi Jan. 1967 155 p
(Contract NAS8-20025)
(NASA-CR-83527; NOR-67-19) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The detailed procedure in designing a localized shell is described. Also presented is a computer program using the finite difference method which serves to guide the engineers in designing and predicting the vibration responses of the localized shell. Author

N67-23284*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF A DOUBLE LINEAR DAMAGE RULE TO CUMULATIVE FATIGUE
S. S. Manson, J. C. Freche, and C. R. Ensign Washington, NASA, Apr. 1967 40 p Refs
(129-03-15-06-22)
(NASA-TN-D-3839) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The validity of a method of predicting cumulative fatigue damage in smooth 1/4-inch-diameter specimens based on the concept of a double linear damage rule was investigated. This method included simplified formulas for determining the crack initiation and the propagation stages and indicated that each of these stages could be represented by a linear damage rule. The data were obtained in two-stress-level tests with maraging and SAE 4130 steels in rotating bending. Also, two-strain-level tests were conducted in axial reversed strain cycling with a maraging steel. The investigation showed that in most cases the double linear damage rule when used in conjunction with originally proposed equations predicted fatigue life with equal or greater accuracy than the conventional linear damage rule. An alternative viewpoint of the double linear damage rule is suggested. This viewpoint requires that a limited number of simple two-stress-level tests be run to establish effective fatigue curves. These curves may then be used in the analysis of any spectrum of loads involving as loading extremes the two stresses used for their determination. Only limited verification of the new method has been obtained to date, and it must presently be limited to the study of smooth, 1/4-inch-diameter specimens. Author

N67-23286*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EMPIRICAL EQUATION RELATING FATIGUE LIMIT AND MEAN STRESS
I. E. Figge Washington, NASA, Apr. 1967 30 p Refs
(NASA-TN-D-3883) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An empirical relation was developed to predict the fatigue limit of axially loaded unnotched specimens as a function of mean stress. Both the ultimate tensile strength and the fatigue limit at zero mean stress are required in the basic equation. An ancillary equation was developed to represent the fatigue limit at zero mean stress as a function of the ultimate tensile strength. Comparisons demonstrating the improvement of the proposed relations over other relations are presented for five major material classes: bare aluminum, clad aluminum, low alloy steels, stainless steels and superalloys, and titanium alloys. The proposed method predicted that it was possible to obtain a fatigue limit equal to the ultimate strength of the material. Various materials tested at approximately the stress levels predicted by the method had not failed after 2.5×10^8 or more cycles. Author

N67-23289*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NUMERICAL METHOD FOR DETERMINING THE AEROELASTIC DIVERGENCE CHARACTERISTICS OF UNGUIDED, SLENDER-BODY, MULTISTAGE LAUNCH VEHICLES
Clarence P. Young, Jr. Washington, NASA, Apr. 1967 49 p refs
(NASA-TN-D-3893) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A rigorous matrix recurrence solution to the system equations based on a fine difference approach yields the stability boundary at which aeroelastic divergence would occur. The stability criterion for acceptable design is reviewed and results of comparative analytical studies are illustrated. Secondary influences on aeroelastic divergence, such as thrust and aerodynamic cross flow, are incorporated and results of studies to ascertain the significance of these secondary influences are included. Example input data are presented and discussed along with illustrated output results. Comprehensive parameter studies are included to indicate corrective measures that may be used to avoid aeroelastic divergence. Author

N67-23294*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF COMPOSITION, DENSITY, AND ENVIRONMENT ON THE ABLATIVE PERFORMANCE OF PHENOLIC NYLON
Robert T. Swann, William D. Brewer, and Ronald K. Clark Washington, NASA, Apr. 1967 30 p refs
(NASA-TN-D-3908) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Good thermal protection performance was demonstrated for a mixture of 25 percent powdered phenolic resin, 50 percent powdered nylon, and 25 percent phenolic Microballoons, molded to a density of 36 lbm/ft^3 (580 kg/m^3). (Percentages are based on weight.) Experimental results are presented which show the effects of composition and density on ablative performance of phenolic and nylon mixtures. Densities of 25 to 30 lbm/ft^3 (400 to 480 kg/m^3) give best performance, but performance is not a strong function of either density or composition. Char spallation is observed under certain heating conditions, particularly with high nylon content and/or low density. The thermal protection effectiveness of a castable phenolic nylon was investigated and found to be about one-half that of the molded material. Author

N67-23307*# TRW Systems, Redondo Beach, Calif.
TECHNIQUES FOR THE OBSERVATION OF MICROMETEORITE CRATERS IN METAL SUBSTRATES UTILIZING ELECTRON MICROGRAPHIC REPLICA METHODS
J. C. Slattery and R. Sloan Washington, NASA, Apr. 1967 Ref
(Contract NASW-1116)
(NASA-CR-768) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A program is being conducted to develop, refine, and reduce to routine practice the techniques required to obtain high quality electron micrographs of craters in metallic targets produced by microscopic hypervelocity particle impact. The program requires that the craters, ranging in size from 0.1 to 10 microns, be reproduced so that the various crater dimensions can be accurately measured. Direct and indirect replication processes, which both terminate with a preshadowed atomic replica available for viewing, are described. The crater depths of aluminum substrates impacted by iron particles are all equal to or greater than the crater diameters. This has caused a serious problem in reproducing duplicate replicas because of the difficulty in removing the replicas without tearing or altering them. With aluminum substrates, a roughening on the crater floors was encountered which was not reproducibly replicated. The craters formed in stainless steel substrates were in no case deeper than the diameters of the craters and good replication was accomplished by thin film methods. Several electron micrographs are shown to illustrate pertinent details and conditions found in the craters. R.N.A.

N67-23308*# Washington Univ., Seattle.
PLANE-STRESS, ELASTIC-PLASTIC STATES IN THE VICINITY OF CRACK TIPS
A. S. Kobayashi, S. Woo, and R. C. Shah Washington, NASA, Apr. 1967 49 p refs
(Grant NsG-532)
(NASA-CR-772) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The von Mises yield condition and flow rule are used to analyze the elastic-plastic states in the vicinity of the tip of a straight crack in a thin plate. Elastic-perfectly-plastic material is considered, and the yield zone is assumed to be small in comparison to the crack length. The numerical method of finite differences is used together with a specially developed iteration operation to solve the nonlinear equations involved. Two cases are analyzed: a plate subjected to uniform in-plane shear and a plate subjected to uniform tension. States of stress in the elastic-plastic regions are determined together with the boundaries of the yield zone. The numerical results show that stress distributions satisfy the $1/\sqrt{r}$ relation approximately for points away from the crack tip but in the plastic region. These results lend some theoretical support to the plasticity correction factor as utilized in the Griffith-Irwin approach to fracture.
Author

N67-23317*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FINITE ELEMENT MODELING OF A CIRCULAR RING USING HALF AND QUARTER SYMMETRY
William L. Cook Dec. 1966 22 p Refs
(NASA-TM-X-55748; X-321-66-587) CFSTI: HC $3.00/MF $0.65 CSCL 13M

The dynamic mode shapes and frequencies of a circular ring are obtained using finite element techniques. The results obtained from models making use of half symmetry and of quarter symmetry are compared with those for the complete ring and with the exact solution. The half-ring model provides the same solution as the complete ring. The quarter-ring model, however, must be subjected to two separate sets of boundary conditions in order to obtain the complete set of mode shapes. This same quarter-ring model is then subjected to a third set of boundary conditions to obtain the same solution as an infinitely long "corrugated" wire.
Author

N67-23351# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE STABILITY OF DYNAMIC AND ELASTIC SYSTEMS WITH ALMOST PERIODIC OR NEARLY PERIODIC EXCITATION
J. Abel Dec. 1966 192 p refs
(R66SD65; AD-803799) CFSTI: HC $3.00/MF $0.65

The second order linear differential equation with an almost periodic or nearly periodic coefficient is analyzed. In the almost periodic case, the governing equation represents a generalization of the Mathieu equation. Characteristic solutions and corresponding characteristic values are developed. In the nearly periodic case, the asymptotic equivalence of the exact solution and the solution to a related equation which is a periodic approximate is investigated. Applications are drawn from the problem of the stability of an elastic column and the attitude motion of an artificial satellite.
Author (TAB)

N67-23474 General Technology Corp., Elgin, Ill.
STRESS CONCENTRATIONS IN TWO NORMALLY INTERSECTING CYLINDRICAL SHELLS SUBJECT TO INTERNAL PRESSURE
A. C. Eringen, A. K. Naghdi, S. S. Mahmood, C. C. Thiel, and T. Arman Jan. 1967 118 p refs
(Contract NObs-94173)
(TR-3-9)

This report covers the theoretical analysis of two normally intersecting cylindrical shells having ratios of radii ρ_0/R not greater than 1/3. Both shells are considered to be infinitely long, capped at the ends and subjected to internal pressure. The exact solution of the partial differential equation of Donnell's theory of thin cylindrical shells is obtained in the form of infinite series. Fourier expansions and the method of least square error are employed to satisfy the boundary conditions. Various numerical results are presented at the end of the report.
Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-22041*# Israel Program for Scientific Translations, Ltd., Jerusalem.
NON-STATIONARY HEAT AND MASS TRANSFER
I. G. Gurevich, I. P. Zhuk, and N. G. Kondrashov, ed. 1967 163 p refs Transl. into ENGLISH of the book "Voprosy Nestatsionarnogo Perenosa Tepla i Massy" Minsk, Akad. Nauk Belorussk. SSR, 1965 Published for NASA and NSF
(NASA-TT-F-432; TT-67-51368) CFSTI: HC $3.00/MF $0.65 CSCL 20M

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N67-22042*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THERMAL CONDUCTIVITY OF EXOTHERMIC BODIES

A. G. Temkin *In its* Non-Stationary Heat and Mass Transfer 1967 p 1–10 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Mathematical expressions are developed to describe the temperature fields surrounding partial and complex heat sources, and to describe the changes in the surroundings and the internal heat sources. The temperature field is discussed in terms of the internal evolution of heat, convective heat exchange with the surroundings, and the nonhomogeneous initial temperature distribution. The external-action and after-effect field components are considered. Emphasis is placed on the sum of the action field of the surroundings and the internal heat sources. N.E.N.

N67-22043*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A CONTACT PROBLEM FOR A GENERALIZED SYSTEM OF DIFFERENTIAL EQUATIONS OF HEAT AND MASS TRANSFER

P. V. Tsoi and O. B. Kianovskii *In its* Non-Stationary Heat and Mass Transfer 1967 p 11–17 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Continuous changes in the potential fields of generalized charges and their fluxes at the contact surface between two bodies are considered mathematically. It is assumed that the functions of the specific flux of the generalized charge (heat or mass) at the contact boundary between the two media are known. The Fourier cosine transform and the Laplace transform are applied to the two independent boundary aspects of the contact problem of heat and mass transfer. N.E.N.

N67-22044*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE UNSTEADY CONVECTIVE HEAT EXCHANGE WITH AN OSCILLATING BODY

A. L. Parnas *In its* Non-Stationary Heat and Mass Transfer 1967 p 18–21 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Experimental results from research done on the heat exchange with a cylinder in a transverse air stream, with the cylinder oscillating transversely and parallel to the air flow are discussed. It is pointed out that when using the dimensionality methods, two factors must be introduced into the equation; one equal to the frequency times and cylinder diameter divided by the absolute velocity, and the other the ratio of the amplitude to the diameter. The results are graphed and discussed in terms of these factors. N.E.N.

N67-22045*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL STUDY OF HEAT EXCHANGE IN THE CASE OF A CYLINDER IN A TRANSVERSE AIR STREAM

A. L. Parnas *In its* Non-Stationary Heat and Mass Transfer 1967 p 22–26 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Details are presented on the experimental apparatus and procedures to study the heat transfer from an air stream to a cylinder, from initial turbulent heat flow to a steady state condition. The results are graphed and fluctuations in the heat transfer are discussed. It was suggested that the time of transition to the steady state is determined not only by the time expended for heating the air in the vicinity of the cylinder but also by the time of rearrangement of the velocity fields. Results of further experiments were considered to validate this suggestion. N.E.N.

N67-22046*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THERMAL RELATIONS DURING THE GRINDING OF METALS, AND A PRACTICAL METHOD FOR THEIR CALCULATION

V. F. Sovkin and M. P. Shatunov *In its* Non-Stationary Heat and Mass Transfer 1967 p 27–58 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

A numerical analysis of the temperature fields and heat fluxes during the grinding process is presented. A method is described for determining the distribution of the contact heat between the interacting bodies, taking into consideration the heat removed by a coolant. Calculations are simplified by use of tables which are included. Heating of workpieces with an irregular ribbon source and the steady temperature during multipass grinding are discussed. N.E.N.

N67-22047*# Israel Program for Scientific Translations, Ltd., Jerusalem.

RECONSTRUCTION OF THE HEAT AND MASS CONTENT FIELDS OF A COLLOIDAL BODY

A. G. Temkin *In its* Non-Stationary Heat and Mass Transfer 1967 p 59–66 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Equations of the energy and mass transfer are presented, and the solution of the system of transfer equations is discussed for conditions within the bulk of the body. The field reconstruction is carried out using parameters whose values are experimentally known. Emphasis is placed on the solutions to the problems of reconstructing the moisture field, and the temperature field of a moist body. N.E.N.

N67-22048*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF THE SORET COEFFICIENTS AND THE CONCENTRATION DIFFUSION COEFFICIENTS BY AN UNSTEADY-STATE METHOD

G. I. Bobrova and G. D. Rabinovich *In its* Non-Stationary Heat and Mass Transfer 1967 p 67–74 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

An experimental procedure and theoretical calculations for determining the Soret coefficients and the concentration diffusion coefficients under non-isothermal conditions for thermal diffusion columns are presented. Approximation and integral transform methods are applied to the solution of the partial differential equations. It is shown that the changes in concentration on the two surfaces are not equal, and the asymmetry is discussed. The experimentally determined and theoretically calculated results were considered to be in good agreement. N.E.N.

N67-22049*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INTENSIFICATION OF THE THERMAL DIFFUSION SEPARATION PROCESS IN A CLUSIUS-DICKEL COLUMN

G. I. Bobrova and G. D. Rabinovich *In its* Non-Stationary Heat and Mass Transfer 1967 p 75–80 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

An experiment is described in which barriers are introduced into the column at a location which corresponds roughly to the supposed natural boundary between the two currents. The barrier is perforated to permit transverse molecular transfer in the thermal diffusion process. The barrier has the single purpose of creating an ordered liquid flow with simultaneous transverse transfer. The slit dimensions are of the 0.6–1.1 mm range. The degrees of separation for the column with and without the barrier are compared, and graphs of the separations are presented as a function of the open area of the barrier and as a function of the distance between the walls. The proposed method is found to achieve a higher degree of separation with much wider gaps than without a barrier. N.E.N.

N67-22050*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EFFECT OF THE VIBRATION RATE OF A BODY ON HEAT AND MASS TRANSFER UNDER THE CONDITIONS OF VACUUM SUBLIMATION

P. A. Novikov *In its* Non-Stationary Heat and Mass Transfer 1967 p 81–85 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Results are reported on the experiment carried out over a frequency range of 20–150 cps, with an oscillation amplitude of 1–18 mm, a pressure range from atmospheric to 0.1 mm Hg, and at constant 18°C temperature. Details are presented on the apparatus and procedures, and the data are graphed. It was determined that the effect of vibrations of the body on the sublimation rate and the convective heat transfer rate becomes noticeable only if the vibrations have a large amplitude. A marked effect was noticed when the amplitude was greater than the characteristic size of the body undergoing sublimation. N.E.N.

N67-22051*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE MECHANISMS OF HEAT AND MASS TRANSFER DURING THE VIBRATIONS OF A BODY UNDERGOING SUBLIMATION IN A RARIFIED GASEOUS MEDIUM UNDER THE CONDITIONS OF FREE CONVECTION

P. A. Novikov and B. M. Smol'skii *In its* Non-Stationary Heat and Mass Transfer 1967 p 86–91 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Experiments to determine the dependence of the transfer rates on the vibration velocity of a body undergoing vacuum sublimation during steady state and free convection conditions are reported. A sharp increase in the heat transfer rate was observed when the Reynolds number of vibration exceeded a critical value, and it was concluded that below this value and in the pressure range between 745 and 50 mm Hg, the heat transfer is affected mainly by the free convection, and that at pressures between 50 and 0.1 mm Hg the heat transfer process is affected to a marked degree by the mass transfer. A good correlation between mass transfer data and heat transfer data between 745 and 50 mm Hg was obtained. With small vibration amplitude the transfer processes are considered to be governed by conventional mechanisms, but with large amplitudes the vibrating body creates a strong perturbation and the amplitude and velocity govern the hydrodynamic behavior of the medium. The influences of vaporization rates and direction of oscillation with respect to gas flow are also discussed. N.E.N.

N67-22052*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE MASS TRANSFER COEFFICIENT OF AIR

L. M. Nikitina *In its* Non-Stationary Heat and Mass Transfer 1967 p 92–95 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

Equations are developed for calculating the values of the mass transfer coefficient of air, and the results are tabulated. The method is based on the density of the moisture flow on the boundary surface between the capillary-porous body and its surroundings, and utilizes the chemical potential of mass transfer. N.E.N.

N67-22053*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE SPECIFIC ISOTHERMAL MASS CAPACITY OF HUMID AIR

L. M. Nikitina *In its* Non-Stationary Heat and Mass Transfer 1967 p 96–97 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

The method of calculating the specific isothermal mass capacity based on the moisture content and the chemical potential of mass transfer is briefly outlined, and the values are tabulated. It is pointed out that the specific capacity values are necessary in calculating the mass transfer from a colloidal capillary-porous body to air when a difference in the chemical potential of mass transfer exists between them. N.E.N.

N67-22054*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME PROBLEMS OF THE FLUIDIZED-BED DRYING OF HEAT-SENSITIVE MATERIALS IN A CYCLIC REGIME

I. F. Pikus *In its* Non-Stationary Heat and Mass Transfer 1967 p 98–105 refs (See N67-22041 11-33) CFSTI: HC $3.00/MF $0.65

The parameters for achieving optimum efficiency in the fluidized-bed drying under cyclic conditions are reviewed, and equations for the approximate calculation of the kinetics of heating of a moist disperse material are presented. The time dependence of the moisture and temperature fields, the cycle frequency, the temperatures of the drying agent and of the cooling air, and the drying time are all covered. The approximate calculation method for the symmetric high frequency cyclic conditions employs the cosine law for the drying agent temperature changes and for the drying rate. Expressions are also given for the heat capacity of the drying agent and the heat of vaporization. The approximation method was compared to data from experiments and the discrepancy was found not to exceed 10–12%. N.E.N.

N67-22055*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPERIMENTAL DETERMINATION OF THE MASS TRANSFER COEFFICIENT IN THE COOLING OF MOIST GRAIN AFTER DRYING IN MULTISECTIONAL PACKED HEAT EXCHANGERS

A. I. Lyuboshits *In its* Non-Stationary Heat and Mass Transfer 1967 p 106–108 (See N67-22041 11-33) CFSTI: HC $3.00/MF$0.65

Experimental data on the dependence of spontaneous evaporation on the temperature of the grain for a 15% moisture content are presented and discussed. The effect of mass velocity of air on the mass transfer coefficient and on the Kosovich number are also included. An analysis of the data indicates that the partial pressure of water vapor is equal to $5.3\theta^2$, where θ is the temperature of the material. N.E.N.

N67-22056*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF THE OPTIMUM THICKNESS OF LAYERS IN MULTISECTIONAL PACKED HEAT EXCHANGERS

A. I. Lyuboshits *In its* Non-Stationary Heat and Mass Transfer 1967 p 109–111 *ref* (See N67-22041 11-33) CFSTI: HC $3.00/MF$0.65

Because the effectiveness of the heat exchange and the energy consumption increase as the layer thickness increase, consideration is given to determining the optimum thickness of the layer of a multisectional packed heat exchanger. Equations are formulated to calculate the dimensions of the heat exchanger. It is pointed out that an increase in the δ/d ratio (ratio of layer thickness of the material in each section to the particle diameter) above 35 to 40 is not expedient, and at the above ratio the value of the coefficient of effectiveness of the packed multisectional heat exchanger ϵ is sufficiently high. A further increase in δ/d results in a negligible increase in ϵ but at the same time causes a sharp increase in the layer resistance. L.E.W.

N67-22057*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DEPENDENCE OF THE COMBUSTION RATE OF COKE PARTICLES ON THE FLOW RATE ROUND THE PARTICLES, IN A GENERALIZED DIMENSIONLESS FORM

Yu. A. Finaev *In its* Non-Stationary Heat and Mass Transfer 1967 p 112–114 *refs* (See N67-22041 11-33) CFSTI: HC $3.00/MF$0.65

An equation is given to satisfy the diffusion limit of the specific rate of combustion in the case of forced flow; with the aid of certain transformations it is presented in a dimensionless form. These equations show that the value of the dimensionless complex may vary from a constant (0.75) in the case of molecular diffusion to a value determined by the dimensionless complex at higher stream velocities. Previous data on the burning of electrode graphite, anthracite, and brush graphite are shown on a generalized graph using logarithmic coordinates in the form of an empirical equation. The graph also contains the results of current experiments on combustion rates of peat coke particles, 4.5, 8, and 12 mm in diameter, and electrode graphite particles 5 mm in diameter, at a furnace temperature of 1270°K and a flow velocity (of the gas round the particles) of 0.2 to 1.35 m/sec. The data support the conclusion that the reactivity of peat coke is greater than that of anthracite, electrode graphite, and brush graphite. L.E.W.

N67-22162*# Pennsylvania Univ., Philadelphia.

THERMAL DIFFUSIVITY OF LIQUIDS

Manfred Altman, Ram Sharma, and K. Sreenivasan *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 7 p *ref* (See N67-22161 11-03) CFSTI: HC $3.00/MF$0.65

The thermal diffusivities of the container material boron nitride and of the liquids sodium nitrate and lithium fluoride were determined, and the data are graphed. The surface temperature and the difference between the surface temperature and the temperature at the center of the solid cylindrical boron nitride specimen were monitored on separate recorders. The liquid diffusivity cell was calibrated by testing liquid sodium nitrate, and the data was considered to compare favorably with previously published results. To determine the influence of free convection, lithium fluoride was tested in two containers with different gap widths, and it was concluded that the effects are negligible. N.E.N.

N67-22165*# Pennsylvania Univ., Philadelphia.

STUDIES OF THERMAL TRANSPIRATION FOR THE DEVELOPMENT OF A THERMAL PUMP

M. Altman and E. Hopfinger *In its* Res. in the Conversion of Various Forms of Energy by Unconventional Tech. Mar. 1967 6 p (See N67-22161 11-03) CFSTI: HC $3.00/MF$0.65

Preliminary thermal transpiration data with helium and a porcelain membrane at temperatures below 250° C are reported. The graphed results indicate flow rates, the ratio of gas circulated to gas in the system, and the pressure ratio to temperature ratio versus mean pore diameter to mean free path ratio. N.E.N.

N67-22310# Sandia Corp., Albuquerque, N. Mex.

CALCULATION OF THE THERMODYNAMIC PROPERTIES OF A NITROGEN–ARGON–OXYGEN GAS MIXTURE

K. L. Shipley Dec. 1966 125 p refs
(Contract AT(29-1)-789)
(SC-RR-66-394) CFSTI: HC $3.00/MF$0.65

A summary of the statistical mechanical theory used in computing equilibrium thermodynamics properties of gas mixtures is presented. This theory is then applied to formulate a computational procedure for calculating the properties of a nitrogen–oxygen–argon gas mixture. The initial quantitative makeup of the three-element mixtures is arbitrary; the final composition at a specified temperature and pressure consists of up to 21 particle species. Debye–Hückel theory and second virial computations were added to provide real gas corrections. Quantum energy levels of constituents and sample calculations are given as appendixes. Author (NSA)

N67-22442# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF PLASMA IN LAMINAR AND TURBULENT HYDROCARBON FLAMES

A. S. Sokolik and Ye. S. Semenov 30 Jun. 1966 23 p refs Transl. into ENGLISH of the monograph "Issledovaniye Plazmy v Laminarnykh i Turbulentnykh Plamenakh Uglevodorodov" Moscow, Inst. Khim. Fiz., 1965 p 1–17
(FTD-MT-65-550; TT-67-60296; AD-644006) CFSTI: HC $3.00/MF$0.65

The ionization of hydrocarbon-air flames was studied under conditions of moving spherical flames in a closed vessel (bomb) by means of a one-electrode probe and an oscilloscope. The ion-generating reaction: CH + O to CH(+) + e(-) in hydrocarbon flames occurs due to transfer of OH radicals and O or H atoms in the reaction zone, followed by reaction H + O2 to OH + H. The part played by diffusion within the reaction zone obtains confirmation in measurements of ionization in turbulent flames, in the fact that velocity pulses are followed by pulses of ionization current, and also in that the maximum ionization current amplitudes in turbulent flames increase with the turbulence intensity, and are considerably higher than those for laminar flames in the same mixtures. Analysis of data on ionization in a detonation wave of hydrocarbon-oxygen flames results in two alternative concepts of the mechanism of ignition in a detonation wave. Author (TAB)

N67-22477# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
MAINS-FREQUENCY INDUCTION HEATING OF HIGH-TEMPERATURE FLOWING SODIUM
D. F. Davidson and J. Leece 8 Aug. 1966 23 p refs
(TRG-1273 (R)) HMSO: 4s

A method of mains-frequency induction heating is described, which can be designed to cover a large range of rig requirements and maintain accepted engineering standards for both the containment and the electrical equipment. The heater is in the form of a conventional power transformer except that the secondary winding is a single, short-circuited turn consisting of a stainless steel pipe loop containing the sodium. With suitable lagging and cooling arrangements, the iron core and primary windings can be maintained at temperatures low enough for normal electrical insulating materials. A heater of this type was made and has performed very satisfactorily. A rating of 400-kW is obtained from two 200-kW, three-phase units. The system is designed for a sodium flow of 350 gal/min and an outlet temperature of 670° C. Designs have also been produced for 5-kW and 30-kW outputs. A method is described for determining the leakage reactance of a heater unit using a model pipe loop made from copper in place of the sodium-filled stainless-steel pipe loop. Author

N67-22561# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
CONVECTIVE HEAT LOSSES FROM A GYROSCOPE WHEEL
William H. Keating Oct. 1966 40 p refs
(Contract AF 33(615)-2243)
(E-2046; AD-645705) CFSTI: HC $3.00/MF $0.65

An expression for heat transfer from the surface of a spinning cylinder is derived using Colburns Analogy and is equivalently derived by Martinellis method. The results of a special wheel test are in good agreement with the derivations. Considerations for the wheel sides are discussed. Author (TAB)

N67-22706# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID FLAMES. PART IV: METHANE-RICH FLAMES
G. S. Pearson Aug. 1965 37 p refs
(RPE-TR-6516; AD-477254) CFSTI: HC $3.00/MF $0.65

Burning velocities, temperatures and burnt gas compositions were measured for methane-perchloric acid premixed flames containing from 2 to 18 times as much methane as is required for a stoichiometric mixture. When the amount of methane exceeds twice that in the stoichiometric composition, the excess methane does not react and acts as a diluent. The burning velocity-temperature data correspond to an overall activation energy of 30 kcal using the Zeldovitch, Frank-Kamenetsky and Semenov bimolecular reaction equation. A mechanism is discussed. Author (TAB)

N67-22768*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONTINUING INVESTIGATION OF THERMOPILE CALIBRATION
E. I. Mohr (Columbia Union Coll.) *In its* 1966 Session of the Goddard Summer Workshop [1967] p 393-398 refs (See N67-22741 11-34) CFSTI: HC $3.00/MF $0.65

The testing and calibration of thermopiles is reported. Analytical details on the following topics are included: results of measurements of the field of view of the thermopile, the reflectance of Parson's black, and the calibration of the thermopile by means of quartz-iodine lamps and by means of a blackbody operating at several temperatures. Different calibration curves were obtained for the quartz-iodine lamp and for each blackbody temperature. In the case of each calibration curve, it was found that the responsivity of the thermopile decreased as the intensity of the source decreased. Moreover, the responsivity was greater as the temperature of the source decreased. When the intensity was varied by means of a rotating sector, the responsivity remained constant. R.U.

N67-22795# Aeronautical Research Council (Gt. Brit.).
ON FORWARD EJECTION FOR THERMAL INSULATION IN HYPERSONIC FLIGHT
M. G. Hall Aug. 1963 20 p refs Supersedes RAE-TN-AERO-2910; ARC-25271; See X64-11724
(ARC-CP-752; RAE-TN-AERO-2910; ARC-25271) CFSTI: HC $3.00/MF $0.65

A review is presented of recent work on the flow from a single forward-facing orifice in a supersonic or hypersonic stream. The particular aspect of this work discussed here is how to shape the profile of the orifice and the body so that the ejected gas remains attached to the body and thus envelops it in a smooth layer which can be used to reduce heat transfer to the body surface. Dissipative effects are neglected, except across the detached shock wave. Author

N67-22848*# Aerojet-General Corp., Azusa, Calif.
EVALUATION OF HRL CONDENSING TEMPERATURE CONTROLS
E. F. Perez and W. W. Tingle 19 Jun. 1964 36 p
(NASA-CR-72217; TM-340-64-1-234) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A decision was made to develop a condensing temperature control so that it will be available in the event that such a control is found to be necessary at a later date. This report covers the results of an investigation which was conducted to evaluate three HRL loop controls including a condenser bypass control, a radiator bypass control, and a pump bypass control. The results of the analysis indicate that the condenser bypass system has a higher sensitivity to control flow. Also, a qualitative analysis indicates that the condenser bypass control has a slightly better dynamic response. It is recommended that the condenser bypass control be considered for further development. Author

N67-22857*# Aerojet-General Corp., Azusa, Calif.
CYLINDRICAL RADIATOR WITH INTERNAL HEAT REJECTION
E. F. Perez 22 Apr. 1963 15 p ref
(NASA-CR-72211; TM-345-63-1-105) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analysis of a cylindrical radiator with heat rejection out of the ends is presented along with the resultant axial temperature profile and radiator weight. The analysis is an approximation, based on several assumptions, which permits a rapid evaluation by an iterative process. The results are based on a design point consistent with SNAP-8 prime radiator requirements during operation with maximum heat load from solar and planetary sources. Results were also obtained for operating temperature levels with no external heat load. A size and weight comparison is made with a cylindrical radiator having the interior surface completely insulated. Author

N67-22859*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SUPERSONIC MIXING OF HYDROGEN AND AIR
John H. Morgenthaler Washington, NASA, Apr. 1967 84 p refs
(Contract NOw-62-0604-c)
(NASA-CR-747) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The effects of fuel injection parameters on the mixing of gaseous hydrogen with a supersonic air stream confined within a cylindrical duct was quantitatively studied to provide background

information necessary for the design of combustors for supersonic combustion ramjets. Hydrogen was injected at sonic velocity into Mach 2 and Mach 3 air streams in a 1-inch diameter duct at overall fuel-air equivalence ratios (ER) of 0.17 to 0.50, in both radial (transverse) and axial (downstream) directions from circumferential wall slots. The hydrogen and air supplies were at ambient temperature; air pressure was adjusted to give test section pressures slightly greater than 1 atm. Radial injection gave considerably better penetration and mixing than axial injection at the expense of a greater loss in stagnation pressure. Author

N67-22883* Aerojet-General Corp., Azusa, Calif.
EXPERIMENTAL INVESTIGATION OF FORCED CONVECTION ONCE-THROUGH MERCURY BOILER PERFORMANCE CHARACTERISTICS
A. J. Sellers and M. K. Wong 3 Aug. 1965 129 p refs
(NASA-CR-72221; TM-4933-65-8-311) CFSTI: $3.00 CSCL 13A

Once-through type mercury boiler performance characteristics were studied experimentally in a single tube NaK-to-mercury heat exchanger of concentric counterflow configuration. Heat transfer and two-phase flow pressure drop data were obtained for different mercury flow passage inlet end plug insert geometries. The experimental data were evaluated to determine the validity of proposed semi-empirical boiling heat transfer and two-phase flow pressure drop correlations. The initial boiler performance characteristics are dependent on the mercury flow passage internal wall surface conditioning state and the thermal and dynamic conditions. Elevated liquid phase vortex flow velocity at the preheat section end point combined with similar dynamic conditions in the low vapor quality section demonstrates excellent boiler conditioning effect when the mercury flow passage is cleaned prior to mercury injection. The boiling heat transfer rates obtained from a fully conditioned boiler are in close agreement with the predictions. The introduction of a tight preheat section plug insert geometry providing elevated liquid velocity also improved the boiler performance stability very significantly. Author

N67-22895* Aerojet-General Corp., Azusa, Calif.
PERFORMANCE MAP OF THE SNAP-8-1 MODEL CONDENSER, P/N 092500-1, S/N A-2
A. H. Kreeger 19 Jan. 1966 77 p refs
(NASA-CR-72215; TM-4932-66-381) CFSTI: $3.00 CSCL 18N

An evaluation of the −1 Model Condenser performance is presented when the tests showed that the condenser could meet its required thermal performance during conditions simulating operation in a full system test. Parameters investigated included NaK flow rate requirements to meet fixed condensing pressures, and steady-state response to variations in condensing length and NaK inlet temperature. The calculated value of overall heat transfer coefficients was 1090 Btu/hr-ft^2-°F which was lower than the 1485 Btu/hr-ft^2-°F calculated for an earlier test on a similar unit. However, both condensers tested above the design value of 960 Btu/hr-ft^2-°F. Author

N67-22902# Applicazioni e Ricerche Scientifiche, Naples (Italy).
ELDO FUTURE PROGRAM PRELIMINARY STUDY NO. 3-1 PART 2: NUMERICAL COMPUTATIONS FOR NONEQUILIBRIUM H_2–O_2 ROCKET NOZZLE FLOW
R. Moretti [1967] 54 p refs Prepared for ELDO CFSTI: HC $3.00/MF $0.65

The numerical program written for an IBM 7040 computer is described. The nonequilibrium nozzle flow numerical solutions presented herein is essentially based on the Moretti method. This method initially applied to the constant pressure H_2-air combustion, has been extended in this paper to the analysis of one dimensional nozzle flows for assigned nozzle contours. The one dimensional steady, inviscid case are recalled when chemical reactions are present in gas phase. The particular case of H_2–O_2 reactions is considered. ESRO

N67-22962# Gt. Brit. Ministry of Aviation, London.
HEAT EXCHANGE WITH BOILING CARBON DIOXIDE AT NEAR-CRITICAL PRESSURES [TEPLOOBMEN S KIPYASCHEI DVUOKIS'YU UGLERODA PRI DAVLENIAKH BLIZKIKH K KRITICHESKOMU]
Jan. 1967 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), v. 4, 1964 p 66–71
(TIL/T-5682) CFSTI: HC $3.00/MF $0.65

The heat exchange was investigated in a liquid–vapor system under conditions of free convection, with carbon dioxide boiling on the outer surface of a brass tube heated by water circulating inside. Details are presented on the apparatus, emphasizing the thermocouples and their measurements, and the data are graphed. Well defined maximum and minimum heat flows were observed near the critical pressure. These extreme values decreased with increasing pressures, and at 75 kg/cm^2 no extreme values were observed. Data show that in a mixed regime of boiling, the local wall temperature is below the critical temperature. Suggested mechanism for the boiling behavior, and for differences from published material are presented. N.E.N.

N67-23072# Institut Franco-Allemand de Recherches, St. Louis (France).
NON-IDEAL DETONATION WITH CONSTANT LATERAL EXPANSION
F. Wecken 29 Jun. 1965 30 p refs Presented at the 4th Symp. on Detonation, White Oak, Md., Oct. 1965
(ISL-T-19/65) CFSTI: HC $3.00/MF $0.65

Based on simple assumptions for the equation of state, reaction rate, and increase of cross section behind the shock front, ordinary differential equations are established which determine the structure of the reaction zone of a steady non-ideal detonation in a perfect gas. Starting the numerical integration at the CJ point, profiles of the reaction zone for $\gamma = 1.4$ and $\gamma = 3$ are obtained, and examples are presented in the form of graphs. The range and limit of detonation for a given initial state are discussed and for $\gamma = 1.4$ some limit curves are plotted. Some concluding remarks concern nonsteady detonations. Author

N67-23126# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID FLAMES. PART V: ETHYLENE-RICH FLAMES
G. S. Pearson Mar. 1966 33 p refs
(RPE-TR-66/1, Pt. V; AD-645817) CFSTI: HC $3.00/MF $0.65

Burning velocities, temperatures and burnt gas compositions were measured for ethylene-perchloric acid premixed flames containing from 2 to 24 times as much ethylene as is required for a stoichiometric mixture. Soot formation is observed for a limited range of mixture ratios. When the amount of ethylene exceeds three moles per mole of acid, the excess ethylene does not react but functions as a diluent. The results are compared with those for methane-rich flames and a mechanism is proposed. Author (TAB)

N67-23137# Pennsylvania State Univ., University Park. Dept. of Fuel Science.
ON RADIATIVE HEAT TRANSFER IN SOLIDS
R. H. Essenhigh Oct. 1966 36 p refs
(Contract Nonr-656(29))
(FS66-2; AD-645230) CFSTI: HC $3.00/MF $0.65

Analysis of radiative heat transfer inside a solid in which there is simultaneous transmission, absorption, and re-radiation

(and conduction is neglected) leads to two simultaneous integral equations whose solution leads to a temperature (T)-distance (x) profile (at steady state) of the form T to the 4th power = T (T sub zero) to the 4th power - (kB/2 sigma)x where k is the specific absorbtion for the material, B the net radiative heat transfer, sigma is Boltzmans constant. Values of k (assumed independent of temperature and wavelength) for which radiative heat transfer is estimated to be a significant contribution range from 0.1 to 100 (clear, transparent glasses to opaque grey solids). In combustion and ablation situations calculation of the time constants for establishment of radiative and conductive steady-state show that radiation might even be the dominant mode of heat transfer. Another result that emerges from the analysis is an equation for the overall solid emissivity which is found to vary with the temperature profile inside the solid. Author (TAB)

N67-23211# Los Alamos Scientific Lab., N. Mex.
THERMODYNAMIC PROPERTIES OF PLUTONIUM OXIDES
R. N. R. Mulford and C. E. Holley, Jr. [1966] 41 p refs
(Contract W-7405-ENG-36)
(LA-DC-8266) CFSTI: HC $3.00/MF $0.65

Thermodynamic data are given for plutonium dioxides and the phase diagram is given for the Pu-O system. A close analogy is drawn between the plutonium oxides and the rare earth oxides. Established structures for the plutonium oxides are also discussed. NSA

N67-23231# California Univ., Livermore. Lawrence Radiation Lab.
THE DETERMINATION OF LOCAL AND MEAN HEAT TRANSFER COEFFICIENTS IN TUBES AT HIGH HEAT-FLUX DENSITIES
W. Hufschmidt, E. Burck, and W. Riebold Aug. 1966 70 p refs Transl. into ENGLISH from Intern. J. of Heat and Mass Transfer, v. 9, 1966 p 539–565
(UCRL-TRANS-10064)

In the determination of local and mean heat transfer coefficients of flowing media in or on directly electrically heated tubes, two measuring processes are commonly used in order to determine the nonmeasurable temperature T_w of the cooled surface: either the temperature T_{is} of the noncooled side of the tube wall is measured with thermocouples, or the mean wall temperature T_m is determined from the measured electrical resistance of the tube. It is shown that, because of the principle of measurement, the second process can lead to errors if it is desired to carry out local measurements. The calculation of the temperature differences $(T_{is}-T_w)$ and (T_m-T_w) has been carried out with the aid of the solution of the thermal conductivity equation with heat sources and temperature-dependent characteristics of the wall material. It was shown that in the technically interesting range a simplified solution starting from constant, mean, material characteristics, yields only slight deviations from "accurate" solution (given by an IBM 7090 digital computer). Author (NSA)

N67-23284*# Denver Research Inst., Colo.
THEORETICAL STUDY OF NATURAL CONVECTION FLOWS IN CLOSED-END CYLINDRICAL VESSELS Final Report
C. W. Chiang 20 Mar. 1967 38 p refs
(Grant NsG-518; Proj. DRI-620)
(NASA-CR-83528; DRI-2389) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This study is concerned with the analytical solutions of natural convection flows in closed-end cylindrical vessels to obtain exact solutions of temperature and velocity distribution in the laminar flow region under steady state condition. The temperature and velocity distributions, in general power series of displacements, are substituted into the three basic equations of continuity, momentum and energy. The relationships between coefficients of all powers are obtained through initial and boundary conditions and recurrence formulae. For constant wall temperature conditions the general solution of temperature and velocity may be expressed as a function of displacement, geometry ratio and Rayleigh number. Prandtl number does not enter as an independent parameter. Author

N67-23298*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETERMINATION OF KINETIC PARAMETERS OF SIX ABLATION POLYMERS BY THERMOGRAVIMETRIC ANALYSIS
James B. Nelson Washington, NASA, Apr. 1967 42 p refs
(NASA-TN-D-3919) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Six polymers used in ablation heat shield composites were investigated by thermogravimetric analysis (TGA) at temperature rise rates of 3°K per minute to 18°K per minute in vacuum. These materials were nylon, silicone, polyformaldehyde, and three phenolics. Empirical kinetic parameters were determined for these materials by five different methods (all based on an Arrhenius relation): a direct solution method, an integral method, a maximum decomposition method, a multiple heating rate method, and a difference method. A best set of parameters was determined for each material by comparing experimental TGA curves with TGA curves derived from the parameters found by each method. The kinetic parameters for the individual materials were shown to satisfactorily describe the mass loss of two composite materials of current interest, a low density phenolic nylon and a low density phenolic silicone. Direct solution was found to be the most satisfactory method. Author

N67-23462# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
CALCULATION OF THE VAPOR PRESSURE AND HEATS OF VAPORIZATION AND SUBLIMATION OF LIQUIDS AND SOLIDS BELOW ONE ATMOSPHERE PRESSURE. VIII: XENON
W. T. Ziegler, J. C. Mullins, and A. R. Berquist 29 Apr. 1966 44 p refs
(Contract CST-1154)
(TR-3)

The "best" available experimental thermal data, together with suitable thermodynamic relations, have been used to compute the vapor pressure and heats of vaporization and sublimation of xenon at one degree intervals from 165.02 (the normal boiling point) to 20°K[p = 1.05×10^{-34} mm Hg]. The computed vapor pressures have been compared with the available experimental vapor pressure data. The computed triple point pressure, 612.45 mm Hg, is in excellent agreement with the best experimental value (612.5 mm Hg.). It is believed that the computed values represent the experimental data within the present limits of uncertainty of the measurements and the temperature scales used by the different investigators. The computed values are especially recommended for use in the temperature range below the triple point (161.37°K) where experimental data are scanty or lacking. The computed values are compared with the independently computed values of Gröller and Shorrock. The heat of sublimation of xenon at 0°K has been computed to be 3788 cal/gm mole. The calorimetric entropy of the ideal gas has been re-computed to be 37.708 cal/gm mole °K. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-22261# Connecticut General Life Insurance Co., Hartford, Conn.
AVIATION AND THE NATION: MEASURING THE CHALLENGE OF A CHANGING WORLD
Feb. 1967 80 p refs Presented at the 3rd National Flight Forum Symp., 7–9 Dec. 1966
CFSTI: HC $3.00/MF $0.65

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3. A NEW FRONTIER: INTER-MODAL CONTAINERIZATION J. J. Healy (Flying Tiger Line Inc.) 6 p (See N67-22264 11-34)
4. FORESIGHT AND MYOPIA W. T. Seawell (Am. Airlines Inc.) 7 p (See N67-22265 11-34)
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N67-22262# Connecticut General Life Insurance Co., Hartford, Conn.
AEROSPACE AND THE CITY: SOME QUESTIONS
James W. Rouse (Rouse Co.) *In its* Aviation and the Nation: Measuring the Challenge of a Changing World Feb. 1967 4 p (See N67-22261 11-34) CFSTI: HC $3.00/MF $0.65

Questions are proposed concerning the relationship of the aerospace industry to city development. Such topics as the growth of population, high speed short-hop air transportation, vertical lift aircraft, air noise from high speed transports, and ground transportation to and from the airport are considered. S.P.

N67-22263# Connecticut General Life Insurance Co., Hartford, Conn.
A CRISIS EVOLVES—THE AIRPORT REACTS
Francis T. Fox (Los Angeles Dept. of Airports) *In its* Aviation and the Nation: Measuring the Challenge of a Changing World Feb. 1967 7 p (See N67-22261 11-34) CFSTI: HC $3.00/MF $0.65

The airport crisis involving congestion and delays, too many planes, too much noise, and too many people is considered. It is seen to affect pavement and bridge design, time delays, and the financial status of airports. Cooperation among the government agencies, airlines, aircraft manufacturers, pilot groups, and airport operators is stressed. S.P.

N67-22264# Connecticut General Life Insurance Co., Hartford, Conn.
A NEW FRONTIER: INTER-MODAL CONTAINERIZATION
Joseph J. Healy (Flying Tiger Line Inc.) *In its* Aviation and the Nation: Measuring the Challenge of a Changing World Feb. 1967 6 p (See N67-22261 11-34) CFSTI: HC $3.00/MF $0.65

Modern distribution systems, moving, and storage are discussed with respect to intermodal containerization and the transportation industry. An evaluation of the aircraft from the standpoint of its cubic ratio weight-carrying capacity is presented. The average weight of shipments is described as being in the area of 500 to 550 pounds, however shipments whose weight is under 500 pounds comprise over 60 percent of those received. The emphasis at airports will be on processing systems and storage capability. The advent of intermodal containerization will made regional airports more advantageous to the cargo carriers rather than several stops at airports within a 150-mile radius of a proposed regional concept. S.P.

N67-22265# Connecticut General Life Insurance Co., Hartford, Conn.
FORESIGHT AND MYOPIA
William T. Seawell (Am. Airlines, Inc.) *In its* Aviation and the Nation: Measuring the Challenge of a Changing World Feb. 1967 7 p (See N67-22261 11-34) CFSTI: HC $3.00/MF $0.65

The total aircraft transportation picture for the future is seen to encompass new supersonic aircraft, the so-called "jumbo jets", and the commerical V/STOL AIRCRAFT' A few of the physical changes on the ground will be: expanded airports and landing strips for the V/STOL aircraft, terminals with multilevel gates, multilevel parking for airplanes, and towing devices to cut down on pilot-controlled taxing. Technical improvements will include automatic land capability to permit all-weather operations, computerized in-flight recorders for aircraft safety, and use of communications satellites. S.P.

N67-22266# Connecticut General Life Insurance Co., Hartford, Conn.
THINKING OUT LOUD ABOUT THE GROUND TRANSPORTATION PROBLEM
Martin D. Wohl (Calif. Univ.) *In its* Aviation and the Nation: Measuring the Challenge of a Changing World Feb. 1967 18 p (See N67-22261 11-34) CFSTI: HC $3.00/MF $0.65

Ground transportation is examined from the standpoint of its dependence on air system technology and operation and on the characteristics of residence, business, and industry. Problems are improperly characterized, not insurmountable, capable of improvement, and largely the responsibility and burden of the air transport industry. Various aspects of ground transportation are considered along with possibilities for reducing transport time and effort. Forecasts of the future and tentative solutions include the following: Reductions in flight time will stem mostly from improvements in air traffic control technology rather than increases in cruising speed, since short duration has been achieved for short to medium intercity passenger trips of 800 miles or less. The proportion of air travelers starting or ending trips within downtown and central cores of large cities is not as large as generally depicted and is decreasing. The location of smaller-scale airports (for V/STOL types and trips under 800 miles) would reduce ground access time significantly. S.P.

N67-22267# Connecticut General Life Insurance Co., Hartford, Conn.
AVIATION AND TECHNOLOGICAL PROGRESS: THE SEARCH FOR BETTER WAYS
Feb. 1967 99 p refs Presented at the 3rd Natl. Flight Forum Symp., 7–9 Dec. 1966
CFSTI: HC $3.00/MF $0.65

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4. GENERAL AVIATION TODAY AND TOMORROW W. T. Piper, Jr. (Piper Aircraft Corp.) 7 p (See N67-22271 11-34)
5. A SYSTEMS APPROACH TO AIR TRANSPORTATION PLANNING C. F. von Kann (Air Transport Assoc. of Am.) 10 p (See N67-22272 11-34)
6. A NEW APPROACH TO AVIATION PLANNING J. R. Wiley (Port of N. Y. Authority) 9 p refs (See N67-22273 11-34)

N67-22268# Connecticut General Life Insurance Co., Hartford, Conn.
MEETING THE PROBLEMS OF SUCCESS

William F. McKee (FAA) *In its* Aviation and Technol. Progr: The Search for Better Ways Feb. 1967 6 p (See N67-22267 11-34) CFSTI: HC $3.00/MF $0.65

The problems accompanying the explosive growth of civil aviation are discussed in relation to the intelligent planning which must be done to solve them. Air traffic control and airport facilities are identified as the two factors most sensitive to congestion. An evolutionary approach is suggested as the most feasible way of handling today's traffic, and maintaining compatibility with yesterday's and tomorrow's aircraft. Improvements in control equipment are delineated. Particular emphasis is placed upon the need for cooperation between federal and local governments, the airlines, and aircraft manufacturers in designing and building airports to reduce or eliminate congestion. A brief review of the technical complexities inherent in evaluating the supersonic transport is included. M.G.J.

N67-22269# Connecticut General Life Insurance Co., Hartford, Conn.

THE PROBLEMS AND POTENTIALS OF SHORT-HAUL AIR TRANSPORTATION

Rene H. Miller (MIT) *In its* Aviation and Technol. Progr: The Search for Better Ways Feb. 1967 14 p refs (See N67-22267 11-34) CFSTI: HC $3.00/MF $0.65

The factors affecting the growth of short-haul air transportation were studied to determine whether the problems of terminal delays, weather uncertainties, and cost competitiveness were inherent in the system, or whether they could be solved by new airframe, engine, guidance and control techniques, and management concepts. Operating cost figures are projected to the 1970 and 1980 time periods. An analysis of operating techniques indicated that ground and air maneuvering times could be substantially reduced with VTOL aircraft, and that such an airline is technologically feasible and capable of providing downtown services and mass transportation links. The point is made that consideration should be given to the legislative, administrative, and financial aspects of implementing such a system. The problems involved in capital investment, route allocation, terminal facilities and their siting, and air traffic control are discussed as a basis for future transportation planning. M.G.J.

N67-22270 Connecticut General Life Insurance Co., Hartford, Conn.

JETS IN A HORSE AND BUGGY ERA

Robert E. Peach (Mohawk Airlines, Inc.) *In its* Aviation and Technol. Progr: The Search for Better Ways Feb. 1967 11 p (See N67-22267 11-34) CFSTI: HC $3.00/MF $0.65

The effects of air traffic control delays, terminal congestion, and inadequate ground transportation facilities on regional airline operations are critically assessed. Attention is focused on the New York City area, and several examples are given to illustrate the congestion which exists at the three airports. The economic impact of delays are given in terms of costs to a regional airline which receives an average fare of $17.60 and carries each passenger an average of only 200 miles—an air trip of approximately 45 minutes in the jets. Although the use of jets is considered a competitive necessity, the point is made that the New York City delays nullify the advantages of jet speeds to a large degree. The need of diverting general aviation to satellite airports is also stressed. M.G.J.

N67-22271# Connecticut General Life Insurance Co., Hartford, Conn.

GENERAL AVIATION TODAY AND TOMORROW

W. T. Piper, Jr. (Piper Aircraft Corp.) *In its* Aviation and Technol. Progr: The Search for Better Ways Feb. 1967 7 p (See N67-22267 11-34) CFSTI: HC $3.00/MF $0.65

Statistics are given to show that general aviation comprises nearly 100,000 actively operated airplanes flown by nearly one-half million pilots, as compared to 15,000 military aircraft and approximately 2,000 owned by the airlines. Its economic benefits are assessed in terms of the jobs which it creates, and its use by business and industry. Predicted growth is discussed, and it is estimated that a potential of 390,000 prospects exists in the business flying market alone. Factors which have hampered large scale production are identified as the cost, the complexities of obtaining a pilot's license, and a shortage of landing facilities. Also stressed is the need of more adequate federal planning for the nation's airport and airways systems in order to keep pace with the general aviation industry's requirements. M.G.J.

N67-22272# Connecticut General Life Insurance Co., Hartford, Conn.

A SYSTEMS APPROACH TO AIR TRANSPORTATION PLANNING

Clifton F. von Kann (Air Transport Assoc. of Am.) *In its* Aviation and Technol. Progr: The Search for Better Ways Feb. 1967 10 p (See N67-22267 11-34) CFSTI: HC $3.00/MF $0.65

An air transportation system concept is examined, with consideration given to those areas in which imbalance exists within the framework of the total system. The two principal elements of the system are identified as (1) the airspace environment, encompassing the departure, en route, and arrival subsystems, and the navigation, communications, and traffic control facilities; and (2) the ground environment consisting of airport access/egress, terminal or transfer, and aircraft surface handling subsystems. The developing technology for improving all aspects of the airspace environment is detailed, and long range planning is discussed. Particular attention is focused on the imbalances inherent in the ground environment, and several innovations are given as examples of handling the problem. A plan is suggested whereby mathematical models and electronic computers can be used to forecast data on the movement of passengers and cargo between designated points, and on the total traffic in and out of selected cities. M.G.J.

N67-22273# Connecticut General Life Insurance Co., Hartford, Conn.

A NEW APPROACH TO AVIATION PLANNING

John R. Wiley (Port of N. Y. Authority) *In its* Aviation and Technol. Progr: The Search for Better Ways Feb. 1967 9 p refs (See N67-22267 11-34) CFSTI: HC $3.00/MF $0.65

Comprehensive planning of total aviation needs, which reflects its potential, is recommended as a means of assuring that the development of the national air transport system will coordinate the planning of the air carriers, the manufacturers, the airport operators, and government agencies concerned with surface as well as air transportation. Based on the coordinated approach applied to the supersonic transport problems, the proposal is made for establishing a framework within which an interchange of ideas as well as information can take place, such as a clearinghouse which will furnish a basis for an intelligent appraisal by every segment of the industry on alternate courses of action. M.G.J.

N67-22274# Connecticut General Life Insurance Co., Hartford, Conn.

AVIATION AND THE PUBLIC INTEREST: THE DYNAMIC NEW DIMENSIONS

Feb. 1967 70 p refs Presented at the 3rd Nat. Flight Forum Symp., 7–9 Dec. 1966

CFSTI: HC $3.00/MF $0.65

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1. THE AIRLINES AND THE RAILWAY LABOR ACT B. Aaron (Calif. Univ.) 7 p (See N67-22275 11-34)

2. A CHANGING BUSINESS IN A CHANGING WORLD V. J. Herbert (Airline Employees Assoc. Intern.) 6 p (See N67-22276 11-34)

3. PUBLIC INTEREST IN AIRLINE LABOR DISPUTES REVISITED K. L. Meinen (Am. Airlines, Inc.) .5 p (See N67-22277 11-34)

4. MEETING MANPOWER AND TRAINING NEEDS IN THE AVIATION INDUSTRY S. H. Ruttenberg 11 p (See N67-22278 11-34)

N67-22278# Connecticut General Life Insurance Co., Hartford, Conn.

THE AIRLINES AND THE RAILWAY LABOR ACT

Benjamin Aaron (Calif. Univ.) *In its* Aviation and the Public Interest: The Dyn. New Dimensions Feb. 1967 7 p (See N67-22274 11-34) CFSTI: HC$3.00/MF$0.65

The applicability of the Railway Labor Act (RLA) to the airlines industry is considered. It is argued that the procedures for selecting bargaining representatives are seriously defective; that those governing the settlement of grievances arising under collective agreements are almost wholly irrelevant; and that those applicable to the resolution of disputes over new contract terms are demonstrably ineffective. The repeal of the emergency disputes procedures of the RLA is urged, if the act itself is not repealed. S.P.

N67-22276# Connecticut General Life Insurance Co., Hartford, Conn.

A CHANGING BUSINESS IN A CHANGING WORLD

Victor J. Herbert (Airline Employees Assoc. Intern.) *In its* Aviation and the Public Interest: The Dyn. New Dimensions Feb. 1967 8 p (See N67-22274 11-34) CFSTI: HC$3.00/MF$0.65

A brief history and some of the problems facing labor unions and the airline industry are considered. Jet pilot training, profit sharing, and servicing techniques are mentioned as problems introduced by the use of jets for passenger travel. Federal legislation and the AFL–CIO are examined in connection with problems in industrial relations. Finally, the responsibilities of management and the unions themselves are stressed. S.P.

N67-22277# Connecticut General Life Insurance Co., Hartford, Conn.

PUBLIC INTEREST IN AIRLINE LABOR DISPUTES REVISITED

Kenneth L. Meinen (Am. Airlines, Inc.) *In its* Aviation and the Public Interest: The Dyn. New Dimensions Feb. 1967 5 p (See N67-22274 11-34) CFSTI: HC$3.00/MF$0.65

Collective bargaining and public interest in labor disputes are related to the airlines industry. Airline collective bargaining is particularly responsible to public interest, because of public investment in the technological growth and training of employees. In effect the public is to be the arbitrator through the passage of the Railway Labor Act and its amendments. It is suggested that the rules of collective bargaining, particularly in a public service industry such as the airlines be reviewed and amended so as to provide a more dynamic dimension for the expression and recognition of the public interest in labor disputes. S.P.

N67-22278# Connecticut General Life Insurance Co., Hartford, Conn.

MEETING MANPOWER AND TRAINING NEEDS IN THE AVIATION INDUSTRY

Stanley H. Ruttenberg *In its* Aviation and the Public Interest: The Dyn. New Dimensions Feb. 1967 11 p (See N67-22274 11-34) CFSTI: HC$3.00/MF$0.65

The need for manpower arising from technological progress in the air transportation industry is discussed. The general employment trends anticipated for the future are considered, and the changing occupational requirements are projected for 1975. The Manpower Development and Training Act developed to assist the airlines in meeting training needs is explained, and the Department of Labor's function in manpower research is described. S.P.

N67-22279# Connecticut General Life Insurance Co., Hartford, Conn.

AVIATION AND PUBLIC POLICY: GUIDE LINES FOR GROWTH

Feb. 1967 132 p refs Presented at the 3rd Natl. Flight Forum Symp., 7–9 Dec. 1966

CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. AVIATION AND PUBLIC POLICY S. Gewirtz (United Res. Inc.) 14 p (See N67-22280 11-34)

2. OPPORTUNITIES FOR DEVELOPMENT OF AIR TRANSPORTATION AND ELIMINATION OF SUBSIDY THROUGH STRENGTHENING OF SMALLER CARRIERS L. W. Dymond (Frontier Airlines, Inc.) 11 p (See N67-22281 11-34)

3. FINANCING AIR TRANSPORTATION—THE ROLE OF CAPITAL AND PROFITS IN THE NEXT DECADE E. T. Hinshaw, Jr. (Capital Res. Co.) 8 p (See N67-22282 11-34)

4. ECONOMIC TRENDS AND THEIR POTENTIAL IMPACT ON THE FUTURE INVESTMENT CLIMATE FOR AIRLINE SECURITIES J. J. Kerley (Trans. World Airlines) 30 p (See N67-22283 11-34)

5. THE CHALLENGE FOR MANAGEMENT—THE PERILS OF SUCCESS C. F. McErlean (United Air Lines, Inc.) 7 p (See N67-22284 11-34)

6. COMPETITION, NEW ENTRY AND THE PUBLIC INTEREST J. W. Rosenthal (Civil Aeronautics Board) 22 p (See N67-22285 11-34)

N67-22280# Connecticut General Life Insurance Co., Hartford, Conn.

AVIATION AND PUBLIC POLICY

Stanley Gewirtz (United Res. Inc.) *In its* Aviation and Public Policy: Guide Lines for Growth Feb. 1967 14 p (See N67-22279 11-34) CFSTI: HC$3.00/MF$0.65

Diverse viewpoints on air transportation progress and problems are extensively quoted, and rebuttals are offered to theoretical predictions and prophetic statements. The need for coordinated transportation is stressed in relation to developing the economic policies conducive to continued growth. Several questions are posed as a starting point to stimulate thinking on overall industry problems. These pertain to the explosive growth inherent in the delivery of new equipment and a saturation of existing facilities; concepts of competition; subsidy philosophies; the investment climate needed to attract capital into the airline industry; rates; priorities for public transportation; frequency of jumbo jets and SST operations; airline mergers; foreign competition; and relationships between airlines and travel agents. A plea for intensified efforts in developing the V/STOL is made. M.G.J.

N67-22281# Connecticut General Life Insurance Co., Hartford, Conn.

OPPORTUNITIES FOR DEVELOPMENT OF AIR TRANSPORTATION AND ELIMINATION OF SUBSIDY THROUGH STRENGTHENING OF SMALLER CARRIERS

Lewis W. Dymond (Frontier Airlines, Inc.) *In its* Aviation and Public Policy: Guide Lines of Growth Feb. 1967 11 p (See N67-22279 11-34) CFSTI: HC $3.00/MF $0.65

The growth of the airline industry and the subsidy policy which made it possible are discussed, and the evolution of trunk airlines, involving both small local service companies and large transcontinental operators, is traced. Several decisions of the CAB are given as examples to show the Board's intention of strengthening the smaller trunks so that they could operate without subsidy.

Arguments are offered to show that developing and strengthening smaller subsidized carriers will provide maximum public benefit. The point is made that the trunk carriers are the major beneficiaries of local service subsidy as the local carriers provide airline service to the smaller cities. On the issue of route strengthening, it is concluded: (1) The local service groups have emerged as successful operators but they need route strengthening if they are to become self-sustaining. (2) The public interest supports a balanced route system and the expansion of jet and coach service to broader areas of the country. M.G.J.

N67-22282# Connecticut General Life Insurance Co., Hartford, Conn.
FINANCING AIR TRANSPORTATION—THE ROLE OF CAPITAL AND PROFITS IN THE NEXT DECADE
Ernest T. Hinshaw, Jr. (Capital Res. Co.) *In its* Aviation and Public Policy: Guide Lines for Growth Feb. 1967 8 p (See N67-22279 11-34) CFSTI: HC$3.00/MF$0.65

The potentials for overall economic and financial market growth through the mid-1970's are assessed as background for the air transport industry's capital and profit needs. No change in basic investor objectives are anticipated, i.e., growth of capital, current income, and preservation of principal. Important investment environmental considerations are cited as the broad components of airline earning power which in turn will determine the extent of achieving these objectives. The factors that will ultimately decide the revenue, expense, and profit levels of the air transport industry are categorized as industry, government, labor, carrier managements, and the financial community. Common problem areas are identified as (1) the need to develop greater skills and more sophisticated kinds of information to cope with accelerating technological advances; and (2) the need for a clearer understanding of other viewpoints by management, labor, the financial community, and government. M.G.J.

N67-22283 Connecticut General Life Insurance Co., Hartford, Conn.
ECONOMIC TRENDS AND THEIR POTENTIAL IMPACT ON THE FUTURE INVESTMENT CLIMATE FOR AIRLINE SECURITIES
James J. Kerley (Trans World Airlines) *In its* Aviation and Public Policy: Guide Lines for Growth Feb. 1967 30 p (See N67-22279 11-34) CFSTI: HC$3.00/MF$0.65

The dimensions of recent airline growth and its interrelationship with the overall economy are examined. The vast capital expenditures incurred, triggered by the advent of the jets, are discussed in relation to the problems of profitable operations and return on investment. Composite data on 12 major carriers are presented to show how the airlines used their profits; these include dividend payout, required reinvestment, and capital investment requirement per employee. Emphasis is placed on various trends in the yield produced by the different categories of traffic carried by the airlines, and in the cost of producing a unit of the product. These are considered to show significant warning signals. The problems of multiple competition and flight frequencies are considered, along with the need of developing a greater understanding of demand/price elasticity. The financial problems to be faced by the airlines in the next several years are appraised, and several recommendations are proposed for improving the investment climate to meet the task of raising capital. M.G.J.

N67-22284# Connecticut General Life Insurance Co., Hartford, Conn.
THE CHALLENGE FOR MANAGEMENT—THE PERILS OF SUCCESS
Charles F. McErlean (United Air Lines, Inc.) *In its* Aviation and Public Policy: Guide Lines for Growth Feb. 1967 7 p (See N67-22279 11-34) CFSTI: HC$3.00/MF$0.65

Emphasis is focused on the problem of insuring adequate airport capacity, the solution to which requires the combined cooperation of the airline industry and government agencies. It is pointed out that a major new airport requires some 10 years of planning and construction time, and that vigorous action is required to increase the capacity of existing airports by added runways, new technology, and new traffic procedures. Three categories of solutions are proposed: (1) An awareness of the seriousness of the problem and the consequences of failure to meet it should be created in order to stimulate action by those responsible. (2) A means should be devised to finance the multibillion dollar airport and airport facilities investment required. It is suggested that consideration be given to a program financed by Federal Government loans. (3) Cooperative programs should be launched which would pool the best talent available to attain optimum solutions. M.G.J.

N67-22285# Connecticut General Life Insurance Co., Hartford, Conn.
COMPETITION, NEW ENTRY AND THE PUBLIC INTEREST
J. W. Rosenthal (Civil Aeronautics Board) *In its* Aviation and Public Policy: Guide Lines for Growth Feb. 1967 22 p (See N67-22279 11-34) CFSTI: HC$3.00/MF$0.65

Actions of the CAB pertaining to competition and route development are discussed. These include changes in short haul service; improved air service to small communities by extending local air service; economic strengthening of local and trunk carriers by eliminating uneconomic service duplication, and by actual service termination at traffic-thin points. The increased emphasis on the need for new or improved service in the longer haul domestic markets is considered, along with solutions to what appear to be service gaps or deficiencies through route proceedings. The factors which the Board considers in appraising whether or not it will hear service applications for particular markets are explained. Certain significant themes which underlie the Board's course of decision are detailed. Views on rate policies are offered, and cost comparison figures are presented. M.G.J.

N67-22428*# Missouri Univ., Columbia. Research Center.
THE NATURE AND SCOPE OF AGGLOMERATION EFFECTS OF CITY SIZE AND ADVANCED SCIENTIFIC TRAINING ON INDUSTRIAL RESEARCH LABORATORIES
John C. Murdock 22 Mar. 1967 54 p refs
(Grant NGR-26-004-012)
(NASA-CR-83395) CFSTI: HC$3.00/MF$0.65 CSCL 05I

The concentration of inventive activity in industrial areas is investigated. Urbanization, localization, and large-scale effects associated with the size of the operation of a single decision unit at a particular location are considered, as well as agglomeration variables such as size of city, and local facilities for advanced training in science. The tie between Ph. D. production and availability of local facilities is reflected in respondents replies, and results of the Chi-square tests involving the various elements of the industrial research laboratories operational environment and local Ph.D. production are tabulated. Factors such as the homogeneity of the statistical sample, tests for representativeness of response by geographic area and different city sizes, and the appropriateness of the universe from which the sample was drawn are all taken into consideration. R.L.J.

N67-22491# European Space Vehicle Launcher Development Organization, Paris (France).
ELDO TECHNICAL REVIEW, VOLUME 1, NO. 3
Gauthier-Villars 1966 92 p refs In FRENCH and ENGLISH
CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. CHEMICAL PROBLEMS INHERENT TO USE OF PROPELLANTS ON THE SECOND STAGE OF LAUNCH VEHICLE EUROPA 1 M. Lemoine (Lab. de Rech. Balist. et Aerodyn. de Vernon) p 155-172 refs (See N67-22492 11-04)

2. PCM TELEMETRY FOR ELDO SATELLITE TEST VEHICLE A. Bonanni, A. Magri, and U. Pellegrini (Lab. Electronici e Nucleari) p 173–189 (See N67-22493 11-07)

3. CLOSED LOOP SIMULATION OF OPTIMUM GUIDANCE OF SPACE VEHICLES BY MEANS OF ANALOG COMPUTER TECHNIQUES R. Cosaert and E. Gottzein (Bolkow) p 191–231 refs (See N67-22494 11-08)

4. SOME REMARKS ON THE PHASE–LOCK LOOP E. Cambi p 233–244 refs (See N67-22495 11-10)

N67-22509# RAND Corp., Santa Monica, Calif.
MAINTENANCE DATA COLLECTION AND WORKLOAD CONTROL INFORMATION SYSTEMS: A CASE STUDY
I. K. Cohen, O. M. Hixon, and Barbara G. Marks Nov. 1966 69 p refs
(Contract AF 49(638)-1700)
(RM-4965-PR; AD-645994) CFSTI: HC $3.00/MF $0.65

The two ongoing maintenance information collection systems were analyzed for coverage and control. By matching their records and adding data for maintenance actions not covered, it was found that Workload Control did not control over 72 percent of the total support actions and 34 percent of the total repairs. From the history-oriented documents, it was impossible to determine the number and kinds of jobs. Lack of precoded documents and prepared schedules and poor communications overburdened reporting personnel at peak hours, further degrading the control system. TAB

N67-22587# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 2, NO. 12
Dec. 1966 102 p refs
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. SOVIET HOLOGRAPHY: A STATUS REPORT. I. Y. Ksander p 1–15 refs (See N67-22588 11-23)

2. LUNA-10 REPORTAGE FROM THE VICINITY OF THE MOON B. Doncov p 16–23 refs (See N67-22589 11-31)

3. HIGHLIGHTS OF SOVIET BIOASTRONAUTICS AT THE 17th IAF CONGRESS IN MADRID B. Mandrovsky p 24–37 refs (See N67-22590 11-05)

SCIENCE & TECHNOLOGY NOTES

4. THE 11-YEAR SOLAR ACTIVITY CYCLE AND ITS INFLUENCE ON GEOPHYSICAL PHENOMENA p 38–41 ref

5. DETERMINING THE GRAVITATIONAL FIELD OF THE MOON p 42–45 refs

6. SOVIET LUNAR STATIONS p 45–47 refs

7. LUNAR IONOSPHERE COMPONENTS MEASURED BY LUNA-10 p 47–50 ref

8. SPACE GLIDER DESIGN p 51–53 ref

9. NEW BALL LIGHTNING HYPOTHESIS p 53–58 ref

10. GEOMORPHOLOGY AND TECTONICS OF THE OCEAN FLOORS p 59–62 ref

CONFERENCES

11. THIRD CONFERENCE OF ENVIRONMENTAL PHYSIOLOGISTS FROM CENTRAL ASIA p 63–65 ref

12. STUDY OF THE BAIKAL RIFT ZONE p 65–68 refs

13. BOOK REVIEWS P 69–74

APPENDIX

14. THE 16th INTERNATIONAL CONGRESS OF AVIATION AND SPACE MEDICINE p 75–97

N67-22641*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RESEARCH LABORATORY OF ELECTRONICS QUARTERLY PROGRESS REPORT NO. 84
H. J. Zimmermann and G. G. Harvey 15 Jan. 1967 406 p refs
(Grants NsG-496; NsG-22-009-(163); NGR-22-009-091; NGR-22-009-114; NGR-22-009-131 et al)
(NASA-CR-83421) CFSTI: HC $3.00/MF $0.65 CSCL 20

Research objectives are defined, and summary data on the status of individual projects are presented. These pertain to studies on general physics, plasma dynamics, and communication sciences and engineering. For individual titles, see N67-22642 through N67-22666. Author

N67-22662*# Massachusetts Inst. of Tech., Cambridge.
LINGUISTICS
R. Jakobson, M. Halle, S. Bromberger, J. A. Fodor, J. J. Katz et al *In its* Res. Lab. of Electron. Quart. Progr. Rept. No. 84 15 Jan. 1967 p 261–285 refs In ENGLISH and FRENCH (See N67-22641 11-34) CFSTI: HC $3.00/MF $0.65
(Grants NsG-496; NIH 2-PO1-MH-04737-06; NSF GK-835. Contracts DA-039-AMC-03200(E)); AF 19(628)-2487)

Linguistic concepts on the theory of generative grammar and its use as a basis for the study of cognitive processes are briefly outlined by the M.I.T. school language group. Possible consonant clusters at the beginning of a work in English are examined for a particular type of redundancy that permits a reanalysis of these clusters as single speech segments in the chain. The concept of complex vowel nuclei of syllables being derived from simple vocalic segments is extended. The positioning in linear speech of a limited class of adjectives in modern French is investigated, and the meaning of certain French adjectives is also studied in relation to their position either before or after the noun. R.Li.

N67-22708# Royal Aircraft Establishment, Farnborough (England).
SPREAD OF DECOYS FROM A BALLISTIC MISSILE
G. B. Longden Dec. 1964 31 p refs
(RAE-TR-64074) CFSTI: HC $3.00/MF $0.65

This report establishes the relation between displacement of a decoy at reentry and the velocity with which it was ejected from a ballistic missile body earlier in the trajectory. If decoys are ejected with a constant speed in all directions, the cloud at reentry is very nearly a prolate ellipsoid of revolution, with major axis parallel to the vertical at the mid-point of the trajectory. Some representative values are calculated. Author

N67-22741*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NINETEEN-SIXTY-SIX SESSION OF THE GODDARD SUMMER WORKSHOP Final Report
[1967] 496 p refs Workshop held 15 Jun.–15 Sep. 1966
(NASA-TM-X-55742; X-700-67-94) CFSTI: HC $3.00/MF $0.65 CSCL 20N

Papers on information systems, structural dynamics, magnetic fields and plasma studies, atmospheric studies, and radiation simulation problems are presented. For individual titles see N67-22742–N67-22775.

N67-22969# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
NETWORK PLANNING—SCANS/PERT-CPM/RAMPS. BIBLIOGRAPHY [NETWERKPLANNING—SCANS/PERT/CPM/RAMPS. BIBLIOGRAPHIE]
F. P. van Eck Nov. 1966 62 p refs
(TDCK-46624) CFSTI: HC $3.00/MF $0.65

A bibliography with abstracts is presented of works on network analysis, its application in general, and its specific application in the construction of ships, aircraft, spacecraft, buildings, and in military operations. Included are the systems SCANS, PERT, CPM, and RAMPS. Works published from 1964 through 1966 are represented. Transl. by K.W.

N67-23074# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
SOUNDPRESSURE MEASUREMENTS ON BOARD WARSHIPS . 1 [GELUIDMETINGEN AAN BOORD VAN MARINE SCHEPEN (1)]
T. Houtgast and H. J. M. Steeneken 1966 23 p ref In DUTCH; ENGLISH Summary
(IZF-1966-19; TDCK-47147) CFSTI: HC $3.00/MF $0.65

Purpose of the measurements was to determine to what extent the noise at manned ship stations exceeds the tolerable level. Measurements were made aboard a minesweeper, a chaser, and a frigate of the Dutch navy. The noise spectra, intensity variations, and interference with voice communications were determined. Noise levels for the various stations are shown in tables. The results indicate that the damage-risk criteria for personnel are exceeded in the engine rooms, in boiler rooms, and in diesel generator rooms. Transl. by K.W.

N67-23338*# National Aeronautics and Space Administration, Washington, D. C.
A SURVEY OF SPACE APPLICATIONS
Apr. 1967 140 p refs
(NASA-SP-142) GPO: HC $0.70; CFSTI: MF $0.65 CSCL 22A

The purpose of this survey is to focus attention on the real and potential applications of space technology; to summarize accomplished work, present efforts, and future plans; to identify policy and technical problems; and to provide a selected bibliography. Covered are applications in communications; in the exploration of Earth resources; in geodesy; in meteorology and air pollution control; in navigation, traffic control, and search rescue; in aerospace transports; in space environment therapeutics; and in industrial applications of space resources. K.W.

N67-23400# Swiss Association for Space Technology, (Switzerland).
BULLETIN NO. 3
15 Dec. 1966 20 p In FRENCH and GERMAN
CFSTI: HC $3.00/MF $0.65

Reports are presented by national committees in charge of space research in Switzerland involving science, communications engineering, rocket and satellite techniques, and the horological industry and their current tasks. Activities are also reviewed for the study groups of the Swiss Association for Space Technology, the Swiss research ground station, documentation, and patent and contract problems. More detailed information is given on the research ground station and image reception from meteorological satellites in Switzerland. ESRO

N67-23414# RAND Corp., Santa Monica, Calif.
THE MYTHOGRAPHY OF MILITARY R&D
Robert L. Perry May 1966 17 p refs Presented at the 29th Natl. Meeting of the Operations Res. Soc. of America, Santa Monica, 20 May 1966

A situation is identified in which an unreal representation of events and their causation becomes widely acceptable and is eventually transcribed into a procedural ritual. This situation is considered to be prevalent in military research and development and sufficient to constrain meaningful evaluation of the R&D processes. Relative to this, both the source and the extent of such constraints are suggested. C.T.C.

N67-23429# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
NOISINESS JUDGMENTS OF HELICOPTER FLYOVERS
Karl S. Pearsons Jan. 1967 37 p refs
(Contract FA-65-WA-1260)
(DS-67-1)

Judgment tests were conducted in which 21 college students judged the noisiness or unwantedness of eight recorded helicopter flyover noises vs a jet transport flyover noise and a shaped band of noise. Tests were conducted in an anechoic chamber using mainly the method of paired comparisons. These judgment tests indicate that the calculated perceived noise level is the best predictor of noisiness, followed closely by the N-weighted sound pressure level and the A-weighted sound pressure level, and finally, the overall sound pressure level. Duration and pure-tone corrections applied to the calculated perceived noise level did not improve the prediction accuracy of this measure. Author

N67-23432# California Univ., Berkeley. Operations Research Center.
THE MULTI-COMMODITY MAXIMUM FLOW PROBLEM
Michel Sakarovitch Dec. 1966 87 p refs
(Contract CST-136)
(ORC-66-25) CFSTI: HC $3.00/MF $0.65

This report is concerned with the problem of maximizing the sum of the flows of different commodities in a capacitated network. From theoretical results an algorithm is given which constructs, in a finite number of steps, the multicommodity maximum flow. The constraints under which the total flow has to be maximized are threefold: nonnegativity of flow; capacity—the sum of the flows of the different commodities on a given arc must not exceed a given capacity; and conservation—flow of each commodity is conserved at each intermediary node. It is to be noted that the nice combinatorial features of the one-commodity flow problem are lost when dealing with many commodities: the max flow min cut theorem is not valid and the integrity property of the solution is lost. The problem is a linear program of a special structure. The method presented here, except for a linear system of limited size which has to be solved at each step, is a labelling process. Author

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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